

while the roller or traction engine is working upon the firm travelled way.

**Stone Crushers.**—Three types of stone crushers have been used to a great extent in road building—the gyratory type, the jaw type of the Blake pattern and the jaw crusher of the cam-shaft and roller type. The gyratory type is not very well adapted for portable plants on road work, as the crusher opening is so narrow that the stone requires too much sledging in order to properly feed to the crusher, and the crusher opening is so far above the ground that it requires either a pit or an extremely high dumping platform with a long incline in order to get the stone into the mouth of the crusher. They are also complicated and expensive to keep in repair for work in the eastern part of the country, as it is a long way from the source of supply of the repair parts. For permanent plants where the stone breaks well in blasting, they are a very economical machine.

The advantages of the Blake pattern are the extreme simplicity, there being a less number of reciprocating parts and a less number of bearings which require oiling, than in any other crusher. There is a wedge adjustment by which the crusher opening may be regulated without stopping the crusher. This is an important feature, where enough fine stone must be dumped along the shoulders of the road ahead of the bottom course, as in the case of grouted bituminous work. There is only one tension rod and one spring to keep in adjustment and repair. There are no bearings into which stone chips and dust are liable to enter. This type of crusher I have found to be very economical to maintain and is extremely reliable.

The disadvantages of this type are that for the same size opening, the crushers weigh more than the other type of jaw crushers. They are not so easily transported and handled, the situation and size of the fly wheels in reference to the crusher make it more unhandy to dump close to the crusher than any other type. As a rule the first cost is in excess of the other type of crusher.

The advantage of the cam shaft and roller type crusher is its light weight, which makes it easy to transport and set up, low fly wheels, situated so that the stone may be dumped much closer to the crusher opening than in the Blake type, low first cost and the quick delivery of repair parts. The disadvantages are that it is much more complicated; has more moving parts, more springs and tension rods, than the Blake type. There are more bearings to be lubricated, and the toggle lever shaft is generally situated so that chips and dirt can enter into the bearings. No adjustment can be made regulating the opening of the jaws without removing the toggle which can only be done by shutting down the crusher. Both crushers of the jaw type here mentioned will produce about the same amount of stone for the same size receiving opening and require about the same horse-power to run. All crushers should be fitted with manganese steel jaw plates, as experience has shown that these plates will last about three times as long as the first-class chilled iron plate, and are unbreakable, whereas the chilled iron plate may break or wear out in pockets after running a very short time.

Most all the crusher manufacturers make complete plants composed of bins, crushers, elevators and engines, which are mounted on wheels and can be loaded upon freight cars without being knocked down. Plants built in this style are very economical to handle and set up and are adapted to nearly all kinds of work requiring crushed stone. Where a traction engine is used for hauling stone away from the crusher, it is more economical to have larger bins and longer elevators than are generally furnished with a strictly portable outfit, as it is necessary to have storage capacity in the bins large enough to load a train of traction cars without waiting for the stone to be crushed. On a good many of

these portable outfits, the screen plates and elevator buckets are made of too thin material to wear well, the elevator buckets wearing and rusting away quite rapidly. Unless specially ordered the sprocket wheels and gears are usually made of cast iron. The small sprocket wheels and beveled gears, I think, should be made of manganese steel.

**Crusher Engines.**—Crusher engines should always be large enough to have a surplus of power over and above that which is ordinarily required to run the crushing plant, and the boiler should have additional capacity large enough to supply steam for a steam drill, as in a great many cases, if this is not done, an additional boiler will have to be provided. Most of the states have laws which govern the construction and inspection of boilers, and in the states that have no laws now regulating the construction of boilers, the question is being agitated and undoubtedly in a few years there will be such in most of the states, and as road building has become quite an interstate business, and the machinery is transported from one state to another, care should be taken to procure a boiler which will pass state inspection. I believe that any boiler which is built in accordance with the Massachusetts standard can be used in other states, but there are many boilers which can be used in other states which cannot be used in Massachusetts. Plants equipped with boilers built to the Massachusetts standard, will cost more than boilers usually furnished with crushing plants. These remarks apply as well to road rollers, or any boilers.

**Hauling Engines.**—Where there is enough work to keep a hauling engine busy and suitable provision can be made for loading and unloading quickly, a hauling engine may be used to advantage, and is about 50 per cent. cheaper than hauling with horses. There is still an opportunity for improvement in hauling engines, especially in regard to gearing and traction wheels, most of the makers using cast steel gears that are uncut and very rough, and which wear very quickly. They also use a built-up riveted or bolted wheel with rolled steel rim. These wheels are generally a source of trouble, as the spokes get loose and break where the travelling is rough and stony, as it is on most construction work.

**Road Rollers.**—There is no class of machinery used in road building in which there is so wide a difference in construction and design and first cost as in the steam rollers. They may be obtained in most any shape or size or design that can be thought of. I think that it is generally conceded by road builders, and it has been my own experience, that a double cylinder steam road roller is better adapted for road construction than any other type. There is no class of road building machinery which has been so highly developed. The wide variation in first cost of the different steam rollers makes it very difficult for a contractor or town official to make up his mind which one ought to be purchased. There is almost as much difference in road rollers as there is in watches. You may purchase a watch for a dollar which is liable to keep good time for a year and it is liable not to do so. You may purchase a watch which costs almost any price, and in every case you will probably get just what you pay for. As a general thing, the higher the price up to a certain limit, the more dependable the watch is, and the same rule applies to road rollers. There is no road building machinery sold, that I know of, upon which an exorbitant profit is being made. In looking over a road roller with the view of purchasing, particular attention should be given to an investigation of the gearing and wheels. You can tell by the looks of the wheels and gears upon the machine which has been in use, whether or not that machine is going to do your work day in and day out as it ought to. A set of rear wheels should last, under ordinary service, at least ten years. I have wheels which have been in service fourteen years and