

from clay. This particular type of crushed stone aggregate works very well with either cut-back asphalt or road oil.

In the early days of gravel road building, there was little need of being so particular about the maximum size that went into a road surface; but with the increased traffic of high speed automobiles and trucks, the smoother we keep our road surfaces, the better satisfied will be the traveling public and the less will be the expense to our counties. The modern methods of screening and crushing road materials have gone a long way towards solving our gravel road problems.

Requirements for our processing program in 1937 include the following specifications for bidding:

- (a) All rock up to 6 inches in diameter shall be crushed and screened.
- (b) None shall be retained on a $\frac{3}{4}$ -inch screen.
- (c) Not less than 35% of the crushed content shall be retained on a No. 4 screen.
- (d) Fifty-five to 80% shall be retained on a No. 10 screen.
- (e) The clay content shall not exceed 12%, as indicated by a water gravity test.

USES OF THE MOTOR GRADER

Ivan Craggs

Johnson County Surveyor and Road Supervisor,
Franklin, Indiana

In Johnson County, we have used motor graders for eleven years. We now have six, and our experience has taught us that this unit type lends itself to our road-maintenance problems, and has proved by all odds the best and cheapest kind of road machine we can use. We have 580 miles of county roads, including 80 miles of black-top.

For gravel or stone road maintenance, the motor grader has no equal. Surfaces which have become badly corrugated and pitted under heavy traffic can readily be reshaped and restored to original crown and grade. In this operation, the hard-packed surface is first scarified so that the base may be planed absolutely smooth with the blade. In planing the base, the material is usually windrowed to the sides, then respread on the smooth base. Where the surface is not too hard, the material can be bladed without scarifying, thus saving time and enabling the machine to cover many miles per day.

Another interesting operation, which is favored in many localities, consists of windrowing the surface material to the center of the road, then cleaning and reshaping the ditches. Earth from the ditches is spread over the base from which the gravel or stone has been bladed; then the surface material is replaced over the earth. Ditches are thus restored for proper drainage, and the entire road is reshaped with smooth base and best use of the original surface material.

A heavy motor grader, properly equipped with scarifier, leaning front wheels, and tandem drive, makes an ideal and most economical outfit for this operation. A capable operator with a good machine will finish about one mile a day on such work.

For new road construction, this tool is very well suited in a general way. It will do everything that a tractor and grader will do, except in very rough country, where the cuts and fills are excessive.

On earth roads, the motor grader equipped with tandem drive, low-pressure tires, and leaning front wheels is being successfully and economically used for reshaping and widening, including moderately heavy ditch work, both in making new ditches and reclaiming existing ditches. The added traction supplied by low-pressure tires on tandem drive has made this application possible.

In this type of work, end clearance for the blade is very important, as the point of the blade must work directly behind the front wheel, with sufficient room to prevent clogging the wheel. Not all makes of motor graders have this clearance, and it is one of the features to look for in a machine which is to be used in ditch work.

Traction is also extremely important in this type of work. Low-pressure tires on tandem drive fit into the ditch much better than dual tires and give far better traction. Weight on the driving wheels also enters directly into the matter of traction, and for this reason the trend in newer machines is toward the rear-mounted engine design.

On black-top roads, the motor grader is also used extensively on road mix jobs, both in mixing and in spreading the material. As the unit is mounted on rubber tires, no damage is done to the black-top while under construction or in transporting the machine after the job is done. This may also be said of concrete roads.

Localities in the snow belt make good use of motor graders in plowing snow. Very efficient snow plow attachments are now available for deeper snows, and light snows are effectively handled with the standard blade.

With the power and traction now being built into these machines and the numerous attachments available, motor graders have become our most valuable aid in giving our taxpayers more and better roads. Diesel power, now almost universally available, has greatly reduced the operating cost of road-maintenance equipment. Heavy motor graders are being operated on an average of about 1½ gallons of diesel fuel per hour.

Total operating costs are also surprisingly low. Sixty cents per hour is, I believe, generally considered a fair average for operating cost on a heavy diesel motor grader, for fuel, grease, repairs, cutting edges, etc. An operator at 40 cents per hour

makes a total of \$1.00. On ordinary maintenance work, such a machine will average about four miles per hour, which means 25 cents per mile covered. For a two-round maintenance job, the total cost would be only \$1.00 per mile of road maintained. This covers a real maintenance job with a machine heavy enough to cut a smooth base and preserve the surface material. For low cost, effective maintenance, the modern motor grader is showing results unequalled by any other type of equipment.

GASOLINE POWERED SHOVELS

S. R. Laughlin

Kosciusko County Road Supervisor, Warsaw, Indiana

About ten or twelve years ago, shovel manufacturers placed on the market a gasoline shovel. Until that time, steam power was almost always used. Gasoline-powered shovels have proved very economical, and the manufacturers have made many improvements. In the last three or four years, they have been able to produce shovels in the $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ -cubic yard sizes which are light in weight and durable enough to be practical for the county to use and own.

Last spring, Kosciusko County purchased a new $\frac{3}{4}$ -yard shovel, crawler type, with clam-shell and shovel attachments. We wanted an all-purpose machine, one that we could keep busy throughout the entire season. We have used this machine as a shovel for heavy grading on our new roads, cutting down steep grades on our present roadways, widening intersections, building and widening shoulders on highways, and loading trucks from borrow-pits to fill sink holes. We use it in our gravel pits for stripping the over-burden off the gravel.

This same machine, equipped as a crane, is used for stock-piling in gravel pits, and for loading trucks from stock piles at the side of the road. If we are unloading shipped-in aggregate, we can unload the material to either stock pile or trucks.

In bridge work, it is used for digging bridge abutments, removing old bridges, and placing timbers, steel, etc.

As a dragline, we use it for cleaning out ditches and for peat excavation in sink-holes. This is one of the reasons we purchased a crawler-type rather than a truck-type machine. It makes it possible to move over soft or rough ground where it would be impossible for a truck-mounted machine to travel. This machine can be moved anywhere under its own power, or transported over the highway on a rubber-tired trailer.

We have kept this machine busy constantly from the time it was delivered—six days a week regardless of the weather.

Our costs of construction and maintenance have been greatly reduced since the purchase of this machine. Furthermore, the machine is always available for any purpose; but when such equipment must be rented, it is seldom available when you want it.