find this powdered asphalt dries the fresh oil very quickly, and when used allows traffic on the road within three days.

We have found best results are obtained by making the mixture slightly rich with oil and then, as it comes through to the surface, by coating it slightly with chips or a surface-treatment covering. The chipping must be continued until the surface bleeding is checked. This leaves the surface a light-brown color which will not absorb the rays from vehicle lights and thus cause poor vision at night, as would a dead black color. An average oil mat top should last about two years, after which it should be surfaced with a light oil treatment, another oil mat, a surface treatment or mulch top, as the conditions call for. On heavily traveled roads it may be best to surface-treat the oil mat with standard tar or asphalt treatments within a year or two.

Only a general description of the construction of an oil mat top has been given. Detailed specifications, amounts of material, etc., can be obtained by referring to Indiana State Highway Commission Specification B. This specification will be furnished by the central offices of the Highway Commission at Indianapolis.

In conclusion, I call attention again to the 200 millions invested by the ninety-two counties in these gravel and stone roads. We know that many of these roads are not adequate to serve the traffic now using them. We do not have the money to build better types nor do we like to see large sums spent on them annually in drag maintenance. However, something must be done, for the operating costs are excessive and they are draining the communities of their wealth. I have shown how an oil mat surface constructed on these roads will render fairly good service and the cost is so low that every county is able to take advantage of this type of surfacing. No county should pass up the opportunity.

OPERATING AND MAINTAINING ROAD EQUIPMENT

By Clarence Allender, Hancock County Highway Superintendent

We will separate the discussion on operating and maintaining road equipment into four subdivisions; namely, personnel, equipment, repair, and management.

The personnel should be of the highest type obtainable. Efficient operators are always the cheapest. The men should be careful, thoughtful, and sincere—careful with the equipment, thoughtful in all their dealings with the public, and sincerely conscious of their duties as public servants. Much consideration should be given the men who are going to oper-
ate the equipment, as it is impossible to operate efficiently without efficient operators.

Good workmen require reasonably good wages and are more economical in the long run. Human nature rules that a man will do more and better work when he is really interested in the work he is doing. It will pay to classify the men and give them positions where their interest is centered. It is also well to class them according to their physical qualifications. As an example, our crane operator is a small, quick, alert, precise, accurate, and cautious man; while our motor-grader operator is a six-foot, two-hundred-pound man, who can turn those grader controls all day without any great physical strain on himself. Reward should be shown the trustworthy. When a man is dependable, the superintendent should show him that he appreciates it by giving him some responsibility. No matter how small it is, it shows the man that the superintendent trusts him and has put his confidence in him.

EQUIPMENT

The quantity and kind of equipment depends almost entirely upon the kind of roads to be maintained and the number of miles to be covered. However, it is necessary to have both heavy and light maintaining equipment. Light equipment does very well on side roads at about one third the cost of the heavy equipment. Roads which carry heavy traffic frequently become pitted and, although light equipment cannot remove the pits, it can spread the loose material on the road after the heavier equipment (Fig. 1) cuts it loose. In this manner light equipment can maintain the road between trips of the heavier, slower equipment.

Another important piece of equipment in the maintaining of gravel roads is something with which proper side ditches can be made. A road will not stand up without proper drainage.
Good gravel loading equipment is also essential. A medium-sized crane with clam-shell and drag-line buckets will be found to be very efficient and economical. A crane mounted on caterpillar treads can move on soft footing where other types cannot go. This makes it possible efficiently to load gravel from banks and piles and dip gravel from creek bottoms. By taking gravel from banks or creek bottoms and doing your own screening, you can put good gravel on the road at a much lower cost. This crane will be found useful in many different ways, such as putting in large sewers, making cuts, and cleaning ditches. Many times a creek will wash under an abutment and, if let go, will cause expensive repairs. A few hours' work with the dragline will direct this stream through the center of the bridge and save the expense of repairs. We have handled over 100,000 yards of material with our crane, moving it about 150 miles, and have spent only $16.00 for repairs outside of cables. We load our trucks from a portable bin with a one-inch screen on top. (Fig. 2.)

A county should have two grades of trucks, heavy and light, of some good standard make. Each size should be alike in order that the shop can carry a suitable stock of repair parts without having too much money invested.

**REPAIR**

The average county road department has so much equipment repair work that it is cheaper and more satisfactory to do its own repairing. With a moderately equipped shop, the work can be done quicker and at a price cheaper per hour than if taken to a public garage. First, the county should have a barn for storage, then a smaller building or apartment large enough for at least one piece of equipment. This build-
ing should be heated and have a concrete floor. The shop equipment, besides small tools, should consist of a drill press, a cutting and welding torch, a large anvil, a heavy vise, and a forge. With this outfit, many useful things can be made at the shop for much less than the price asked at retail stores. Among the things we have made, besides all repairs, are a steel gravel bin with screen, snow plows, a high-pressure press, sewer extensions, motor stands, a sliding track for a chain hoist, wrenches, gear pullers, chisels, and punches. When the county has its own shop, it also gets the advantage of wholesale prices on all hardware, parts, and repairs.

Each operator is required to work on his own repair job with the mechanic, because he knows what has happened and why the job is in the shop. Sometimes this information is very valuable to the mechanic. In turn the operator learns some of the adjustments and various details about his piece of equipment from the mechanic. This may be of value to him and the county in keeping the equipment moving instead of bringing it back into the shop for all minor repairs.

MANAGEMENT

We have an assistant superintendent in each of the outlying townships, and the manager of our truck division is in charge of the central township. These men are directly responsible to the superintendent for the condition of the roads. We also have divided the county into two districts. The first three days of the week the western district is in charge of county equipment, and the assistant superintendents in that district are not allowed on the roads. The last three days the eastern district is handled in like manner. Thus we never have any overlapping of authority, but we get the advantage of operating as a county unit and having a local man in direct control.

Therefore we repeat, the better balance a road superintendent can keep in his personnel and equipment, the more successful and economical his operations will be.

GARAGE PROBLEMS

By K. M. Dimmich, Benton County Highway Superintendent

This subject could be handled in many different ways; however, I shall limit my discussion to why and how Benton County secured a highway garage.

Conditions in our county are quite favorable to a central garage. The county is approximately square, being eighteen by twenty-three miles in dimensions; and Fowler, the county seat, is situated near the center. For several years I had