

Methods of Maintenance.—The methods to be employed under any system will vary with the type of road to be maintained and the character of traffic. To deal with these phases of the subject in a satisfactory manner would require more time and space than can be devoted to it in a short paper. This part of the subject will, therefore, be confined to a few brief suggestions regarding the best methods of maintaining earth, gravel and macadam roads.

Earth Road Maintenance.—The first and last commandment in earth road maintenance is to *keep the surface well drained*. To insure good drainage the ditches should be kept open, all obstructions removed and a smooth crown maintained. Except for very stony soil, the road machine or scraper may be used very effectively for this work. The machine should be used once or twice a year, and the work should be done when the soil is damp, so that it will pack and bake into a hard crust. Wide and shallow side ditches should be maintained with sufficient fall and capacity to dispose of surface water. These ditches can in most places be constructed and repaired with a road machine.

All vegetable matter, such as sods and weeds, should be kept out of the road, as they make a spongy surface which retains moisture. Clods also are objectionable, for they soon turn to dust or mud, and for that reason roads should never be worked when dry or hard. Boulders or loose stones are equally objectionable if a smooth surface is to be secured.

A split-log drag or some similar device is very useful in maintaining the surface after suitable ditches and cross-section have once been secured. The drag can also be used on a gravel road just as effectively as on an earth road. The principle involved in dragging is that clays and most heavy soils will puddle and set very hard when wet. The essential requisite, therefore, is that the work be done at the proper time. This is the point which seems to be the hardest to impress on the average man. The little attention that the earth road needs must be given promptly and at the proper time if the best results are to be obtained.

In dragging roads only a small amount of earth is moved, *just enough* to fill the ruts and depressions with a thin layer of plastic clay, which packs very hard, so that the next rain, instead of finding ruts, depressions and clods in which to collect, runs off, leaving the surface but little affected.

The drag should be light and should be drawn over the road at an angle of about 45 degrees. The driver should ride on the drag and should not drive faster than a walk. One round trip, each trip straddling a wheel track, is usually sufficient to fill the ruts and smooth out the surface. If necessary, the road should be dragged after every bad spell of weather, when the soil is in proper condition to puddle well and still not adhere to the drag. If the road is very bad it may be dragged when very wet and again when it begins to dry out. A few trips over the road will give the operator an idea as to the best time to drag. Drag at all seasons, but do not drag a dry road. The road will freeze smooth if dragged just before freezing weather.

The slope or crown should be maintained at about one inch to the foot. If the crown becomes too high it may be reduced by dragging toward the ditch instead of from it. If the drag cuts too much, shorten the hitch and change your position on the drag. If it is necessary to protect the face of the drag with a strip of iron, it should be placed flush with the edge of the drag and not projecting. A cutting edge should be avoided, as the main

object in dragging is to *smear* the damp soil into position. The dragging of roads may be encouraged by offering to caretakers or patrolmen special bonuses or prizes for the best mile of road.

Maintenance and Repair of Gravel and Stone Roads.—The following suggestions may be found useful in the maintaining of gravel and stone roads. Culverts and ditches should be carefully inspected at frequent intervals and all obstructions removed. If the weeds are cut from shoulders and ditches grass will soon take their place. Whenever a mile of new stone road is constructed the contractor should be required to place about 100 tons of 1½-inch stone (ordinarily referred to as No. 2 stone) and screenings at convenient places for maintenance and repairs. During the summer months stone chips only should be used for patching.

The rake is one of the most useful tools used in stone or gravel maintenance. Large patches of stone or gravel should not be spread over the whole road at one time, especially in dry weather. All repairs should be made before cold weather, so that the road will consolidate and go through the winter in good condition. The best time, however, to patch stone and gravel roads is in the spring of the year. The spring showers will aid the traffic in consolidating the materials.

Before applying new material, all projecting stones should be removed and the surface slightly roughened with a pick. In applying new material thick layers should be avoided. One stone deep is ordinarily thick enough, and no stone used for repair work should be larger than two inches in diameter, and the size should be smaller for patch-work.

Trap rock, granites and other hard rocks should be broken finer for repair work than limestones and other softer rocks. Never crack stones on a road if you desire to secure a smooth surface. A thin layer of screenings, preferably trap rock, applied to a gravel road will produce a wearing surface almost equivalent to macadam.

Newly laid stone for patch-work or repairs should be bonded with screenings or a good quality of gravel. An excess of binder, however, should be avoided. In cutting away the worn out material for gravel and stone road shoulders all road scrapings, horse droppings and other rubbish should be kept off the road. Such materials will ruin the best road ever constructed.

The caretaker should never neglect an opportunity to remove loose stones from the road surface. Loose stones or water-worn pebbles should not be used for repairs or maintenance, as they will not bind.

Earth should not be used for patching stone or gravel roads, for earth turns to dust and after the first rain dust turns to mud. A mud blanket over the road will prevent it from drying out and hasten its destruction. The middle of the road should always be a little higher than the sides so that it will shed water quickly. This crowning, however, should not be carried to such an extreme that vehicles are forced to use the centre of the road only, thus confining the wear to two wheel tracks.

If the road is so badly worn or rutted as to require re-building the best practice is to roughen the surface with a scarifier drawn by a roller, or by means of spikes placed in the driving wheels of the roller. The surface is then harrowed and all large stones removed. After bringing the surface to the proper crown and cross-section a layer of No. 2 stone is applied, bonded with screenings, sprinkled and rolled in the same manner as for the original construction.