brooms, bass fibre brooms, in some cases batteries of heating kettles, a distributor to meet specifications and adaptable for the distribution of the kind of bituminous material under conditions stipulated in the specifications, pouring cans, squeegees, and in some cases 5 to 10-ton rollers and hand-drawn or horse-drawn automatic stone chip distributors.

Bituminous Macadam Pavements.—The equipment will depend primarily upon the specifications and the kind of bituminous material employed. The usual equipment consists of batteries of heating kettles, a distributor, pouring cans and a roller. The specifications covering certain features of the distributor may be specific, as in the case of the 1918 specifications adopted by the American Society of Municipal Improvements herewith quoted:—

"The pressure distributor employed shall be so designed and operated as to distribute the bituminous material specified uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than 6 ft. and so that it will be possible on either side of the machine to apply widths of not more than 2 ft. The distributor shall be provided with wheels having tires each of which shall not be less than 18 ins. in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a 2 ft. diameter wheel, 250 lbs. shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of 20 lbs. per in. being allowed for each additional 3 ins. in diameter."

Bituminous Concrete Pavements.—The type of pavement, amount of work, the specifications and the kind of bituminous material employed materially affect the selection of the plant equipment for this class of work. Batteries of heating kettles and a roller are required for the construction of all types of bituminous concretes. Although the practice of contractors has varied to a considerable extent with reference to the weight and type of roller, many now favor the 10 to 12-ton tandem roller for all classes with the exception of Topeka bituminous concrete. Plants of many types have been successfully employed in the manufacture of bituminous concretes. Naturally the most economical and efficient work has been accomplished by a plant especially adapted for mixing the type of aggregate used. Generally, on highway work outside of urban districts, the portable plant proves most satisfactory. Dependent upon the plant accessories, the aggregate is measured by volume or weight before being dried or by weight after drying, the latter being preferable. The aggregate is usually dumped into bucket elevators, which discharge into rotary driers. In the best types of plants, the heated aggregate is then raised by bucket elevators and discharged into a small storage bin. As desired, the heated aggregate is drawn from the storage bin and allowed to fall directly into the pug mill mixer or, preferably, first into a weighing box. The bituminous cement is weighed in scales on the mixing platform and then dumped into the mixer. After thorough mixing, the bituminous concrete is usually discharged into a wagon or truck, which the plant arrangement permits to be placed directly beneath the mixer. For pavements of the type of bitulithic, a rotary screen, several bins and a special weighing device are necessary adjuncts to the plant. For those types of bituminous concrete in connection with which seal coats are employed, the equipment will necessarily be increased by the addition of hand-drawn distributors, pouring cans, squeegees and in many cases hand-drawn automatic stone chip distributors.

Sheet Asphalt Pavements.—The plant equipment necessarily depends upon the amount and location of the work and the specifications. A tandem roller constitutes a part of the equipment for all sheet asphalt work. The mixing plants are of three types, portable, semi-portable and permanent. A complete plant includes a cold-sand elevator, a drier, a hot-sand elevator, a hot-sand storage bin with screen, an asphalt elevator, a flux tank, melting tank, draw-off tank, a sand-measuring box, a dust elevator, bin and measuring box, an asphalt-cement bucket and a pugg-mill mixer.

Cement Concrete Pavements.—Variations in economical equipment depend primarily upon the specifications. A beam and bucket cement concrete mixer, forms, screeds, bridges, belts, long handled light rollers, watering carts, pumps and hose usually constitute the equipment for the construction of cement pavements constructed by the mixing method.

The essential features of a plant are covered by the following excerpts from a report of a committee of the National Conference on Concrete Road Building: "The concrete mixer should be of the batch type provided with an automatic water tank, traction drive and power loader. Mixers having a boom and bottom-dump bucket of sufficient size to convey one complete batch for placing the mixed concrete are preferred. Where necessary to keep from cutting into the subgrade and to facilitate moving, the wheels of the mixer should be run on suitable planking. The mixer should be provided with a suitable automatic water tank which can be quickly filled and emptied, so that when once determined, the required amount of water can be added to each batch of concrete. The power loader or skip should be of sufficient size to hold all the materials required for the batch."

Wood Block Pavements.—For the building of wood block pavements, the equipment should include the necessary apparatus for the construction of the mortar cushion, or a template and hand roller when a sand cushion is employed, a tandem roller weighing from 3 to 5 tons and the necessary distributing apparatus for the application of fillers and the construction of expansion joints.

Brick Pavements.—The equipment should include a wood template and hand roller for the construction of the sand cushion, double metal template for constructing a mortar bed on a green concrete foundation, a tandem roller weighing from 3 to 5 tons, brushes, cement-grout boxes or a small mixer if a cement grout filler is employed, or conical pouring cans if bituminous fillers are used for the construction of transverse or longitudinal joints.

Stone Block Pavements.—The equipment includes, in some cases, templates and hand rollers for the construction of the sand cushion, tampers and the necessary apparatus for filling the joints.

Snow Removal.—Equipment for snow removal is affected by the amount of snow in a storm, the yardage and location of the roads to be cleared. For highways outside of urban districts, road scrapers and horse-drawn and motor plows have been found economical and efficient. In the case of many roads, compaction of the snow being principally required, snow rollers constitute the equipment.

It has been officially stated that since 1912 the Ontario government has built about 2,800 miles of roads, and one-third of these have been in Northern Ontario. "Although the start made has been important, yet the lack of transportation and the largeness of the area seem to make it imperative that the road building program should be enlarged as much as possible in order to keep pace with development of the mining, the farming, the lumber and the paper industries."

The Idaho bill for licensing civil engineers has recently been passed. In this bill, the term "civil engineering" is defined as "the practice of any branch of the profession of engineering other than mining, metallurgical and military. Said profession embraces the design and supervision of the construction of all public or private utilities except those in connection with mining operations exclusively and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."