of solid wood instead of being surrounded by torn and broken down fibres, as is the case when driven directly.

The use of screw spikes, of course, makes pre-boring absolutely necessary. A number of roads are already committed to this form of rail fastening, and its extended use is only a matter of time. At present probably 75 per cent. of the ties that are bored are for square spikes. The possession of a convenient means for cheaply and rapidly doing the boring will cause the early adoption of the screw spike on many roads which would be slow to take it up under other conditions.

Of chief interest, however, to the members of this association is the great advantage from a treating standpoint of having the adzing and boring of ties done before the treatment takes place. The vital points of a tie are the parts under the rails and contiguous to the rail fastenings, and this is where the impregnation should be most thorough. In air seasoning the ties become case hardened on the outside, and this hard skin is more difficult of penetration than the portion immediately beneath. In adzing previous to treatment this more resistant portion is removed for a distance of 12 inches to 14 inches in length for each rail bearing. This permits the chemical to penetrate more freely transversely to the grain. The holes bored for the spikes give the chemical free entrance to the interior, allowing it to radiate from each hole by end grain penetration, thoroughly saturating these portions even when the tie as a whole is not given a heavy treatment. How much this saturation of the parts of the ties subject to earliest failure will increase their life cannot be measured until sufficient time has elapsed to allow accurate comparative data to be obtained, but there is no doubt that it will greatly increase the efficacy of the treatment and produce results far out of the proportion to the cost of the adzing and boring operation. It is stated by the railroad engineers who have had several years' experience with adzed and bored ties that the saving in time and labor in putting the ties in track is sufficient to pay the cost of the adzing and boring, leaving all the other advantages a net gain.

**Adzing and Boring Machines.**—The adzing and boring of ties has been standard practice in Europe for upwards of twenty years, and the results have proved its economy. Owing to the abundance of cheap labor in those countries, the development of machines of the highest labor-saving capacity has not been rapid. Their ties are more carefully made, and therefore machines are not required to meet such wide variations as in this country. In England the majority of ties are sawed from dimension stock and vary little in size. A range of 1½ inch difference in thickness is all that is provided for in their machines, while ours must be designed so that ties from 5 inches to 10 inches thick, and from 7 inches to 14 inches wide, may be run promiscuously. Again, their ties being practically of the same width no provision need be made for centering so that the holes will always be properly placed in the face of the ties. With our extreme variations in width, and the fact that no two ties are alike in shape, that crooked and straight ties must follow each other through the machine, makes it necessary that they be centred over the boring bits so that the holes shall be accurately placed in relation to the centre line of the face of each tie. In other words, the machine must take ties as they come, of all sizes and shapes, and automatically adjust itself to variations and irregularities, without human aid and without decrease in its rate of production.

**Installation.**—Two distinct patterns of adzing and boring machines are built for different methods of mounting. One is designed for installation on a stationary foundation, and the other, a more compact form, for mounting in a car. As more machines are specified for stationary mounting, this type is known as the Standard pattern. It is more open in design and accessible in its working parts than the more compact car type.

The question of which method of mounting is preferable must always depend upon yard and plant conditions, and each case must be decided upon its merits. It is probably true, however, that there are more treating plants in which the stationary mounting will give the higher economy in operation than those in which the movable type will give the better results.

The location of the stationary machine in relation to the retort house, power house, etc., in the case of plants already built, must, of course, be governed by the space that may be available, because it must be made to fit into conditions as they exist. In laying out a new plant the location is subject to control, and can be made where the least switching and handling of ties will be involved.

Wherever possible the machine should be placed between the stacking yard and the cylinders, so that all ties must pass it in their movement between those points. The trackage (narrow gauge) should be arranged so that trams from any part of the yard may be brought to the machine with the minimum amount of switching, and by-pass tracks must also be provided by which timbers not to be machined, such as switch ties, bridge timbers, piling, etc., can pass the tie machine without interfering with its supply. The tram track on the in-feed side of the machine should be about one foot higher than that on the delivery side, and should run out to a spring switch, so that an unloaded tram, given a start, will run by gravity past the spring switch, reverse its direction and return on the discharge side of the machine ready to be loaded for the cylinder. The space required between these supply and delivery trucks should never be less than 32 feet centres when the ties are to be taken from the tram and placed on the machine conveyor by hand. If the dumping hoist and the skid are employed the minimum distance between track centres is 46 feet. These dimensions apply only to the machine without the cut-off saw attachment. If the latter is required, six feet should be added to the track centre distances.

Where drainage will permit, the best form of foundation is to enclose a space 11 feet x 20 feet with a concrete wall, the interior being excavated and a cement floor laid. The side walls should be 7 feet to 8 feet high to give good head room below, as in the basement so formed the 50 H. P. motor for driving the machine is placed, together with the shavings exhaust fan. The top of the foundation should be about three feet above the grade line, making the actual excavation only about five feet deep. Steel I beams and 4 inch plank floor form the support for the machine. The weight of the latter is 20,000 pounds. This form of foundation is not always necessary, but is the most advisable when conditions permit.

Machines designed for mounting in cars perform the same operations in practically the same way, but, as stated before the dimensions are held down in order to bring them within the limit of width of a wide box car, having extra wide doors through which the conveyors extend. The original installation (two machines on the Santa Fe and one on the Northern Pacific) were all of this type.

The car used for this purpose should be of steel underframe construction, forty feet long 9½ to 10 feet wide, and of 40,000 pounds load capacity, and not less than 9 feet high in the clear. The cars are usually made self-propelling from the clear. The cars are usually made self propelling from the same source of power which drives the machine, a clutch being provided by which the machine is disconnected and the car axle drive thrown into gear when the car is to be moved. As the car is commonly designed to move about the tie yard