the increased consumption of steam or gas they demand, are worse evils than putting auxiliary engines down in various positions, and the consequent waste of steam in the long piping to feed these engines. Auxiliary engines, fed from the main boiler, are, it is well known, tremendous steam consumers, and the puting down of auxiliary boilers is out of the question. Here the electric motor forces the argument on its own account. Division and sub-division of labour is the sort of work to which, it may be said, the electric motor is born. For heavy tools a separate motor may be fixed to any machine in any position; and for ligher work, to each line shaft for group driving, likewise fixed anywhere. To estimate the saving here it is only necessary to ascertain what amount of power the shafting and belting and gear wheels will eat up. Fifty per cent. is a fair average. That fifty per cent. is lost by a steam plant. Nearly the whole of it is saved by the use of electric motors. The only loss that occurs in a direct motor drive is the practically negligible loss in the armature.

Lastly, for minor advantages: If the factory is a crowded one, and every inch of floor space is important, the electric motor occupies the least possible space, and can be placed anywhere. It does not darken the workshop with belting and shafting. It does not force the manager to put a new machine where he must, for he can put it where he likes. It usually carries with it its sister advantage—the safe and clean electric light. If steam machinery requires constant skilled attention, the electric motor requires practically none. It is self-regulating. It does not increase the flying dust nor increase the noise nor vitiate the air. And whether electric power be tapped off the mains or privately generated, the first cost of an electric plant properly installed will be saved in most works at from 1 to 3 years.

These, doubtless, afford the chief explanation of the fact that while in other form of industry the steam and gas engine drive can show their ability to hold their own fairly well, the modern sawmill, given suitable conditions, must adopt electric power if it is to have a chance of competing successfully for business. The power required by a wood-working machine is much greater than that needed for a metal-working tool of corresponding size. The transmission losses are, therefore, of much greater importance, and the saving proportionately greater. So true is it that not only do we find most recently established sawmills equipped throughout with the electric drive, but we find that it is considered worth while, in the case of old established mills, to go to the considerable outlay involved in changing over from steam to electricity for the sake of the saving secured. An account of such a change-over attended with the expected results, will be of considerable interest to all sawmill proprietors who still use the steam drive.

The extensive works of Mr. R. A. Naylor, of Warrington, afford one of the numerous cases in point. They cover some ten acres, and comprise sawmills, turning and planing shops, drying stores, and stacking and seasoning sheds, all on the ground floor. There are two large joiners' shops above the sawmills, and a carving room above these. The class of work undertaken varies greatly in character, including every sort of woodwork for dwelling houses, factories, hotels, churches, &c. A large trade is also carried on in heavy timber and scantling required for building purposes. The works are favourably placed on the banks of the river Mersey, which comunicates with the Manchester Ship Canal, whence a direct highway is afforded to the chief timber-producing countries of the world.

These works were driven exclusively by steam for over thirty years, when the opportunities for wide travel and observation which the nature of the business afforded the proprietor, convinced him of the desirability of adopting the electric drive. Warrington already possessed a generating station, which supplied electricity for light and power to the town, and also furnished current in the tramway system. Power was thus available in the most convenient form at the moderate cost of 1d. per unit, after the first 3000 units had been consumed; and the change-over to the electric drive was quickly carried out without in any way dislocating business.

The equipment consists of Westinghouse motors aggregating 250 horse-power, varying in sizes from 5 to 60, some being direct coupled to the machines, others driving groups. The large mill is driven by a 60 horse-power Westinghouse direct-current motor, running at 730 revolutions per minute, and coupled to the shaft by an 11in. belt, the shafting being run under the floor. This shafting drives four large circular saws, one 4ft. diameter, one 3ft., and two 2ft., and a band saw, as well as a 10-ton overhead crane, driven by endless ropes. In the adjoining mill is a log frame, capable of taking work 24 x 6in.; two deals are cut at one time, and six saws can be inserted to reduce the plank to thin boarding. There is also a continuous feed circular saw, driven by a 20 horse-power motor, and running at 1400 revolutions per minute. The motor in Fig. 1 has been bolted to two inclined beams, secured to the ceiling and floor, and is belted to a large planing and moulding machine capable of planing scantlings of any wood up to 14in. x 9in., its output being 15 horse-power at 1100 revolutions per minute. The works abound in modern examples of labour-saving devices for handling timber. Roughing, which could only be tediously performed by hand, is accomplished by these machines with wonderful dispatch.

Two bays of the sawmills exhibit further applications. A 10 horse-power motor, under the floor, drives several concealed lengths of shafting, from which a trenching machine, a circular moulding machine, and a saw bench are operated. A small 5 horse-power motor on a ledge in the wall drives a tenoning machine, whose knives revolve at 2000 revolutions per minute. A chain mortising-machine, operated by belts and counter-shaft, from a 7½ horse-power high-speed motor, is another prominent example of the independent motor drive. The belt shafting and table raising are effected through a single foot lever, depression of which starts the chain and brings the work up until the slot has been cut, the release of the lever being followed by the descent of the table and stoppage of the machine. In the same bay a large moulding machine is driven by a belt from a 15 horse-power motor, the belt being boarded in to shield it from damage by the constant moving of planks, etc., in its neighbourhood.

On the opposite side of this bay a 20 horse-power motor is belted to a length of shafting, and operates three circular saws in the adjoining mill, through shafting under the floor. A motor, developing 30 horse-power at 1050 revolutions, drives an edging machine, a panel planer, and a four-cutter moulder under the same roof as the circular saws, the motor, as in the previous instance, being belted to the shaft. Side by side with this motor is one of 20 horse-power, driving four moulding machines.

Fig. 1. LARGE PLANER AND MOULDER DRIVEN BY 15 H.P. MOTOR.

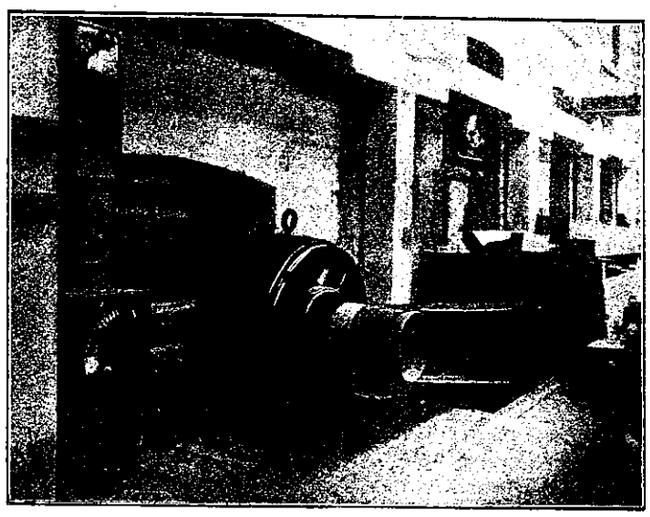

Fig. 2. A 60 H.P. MOTOR DRIVING LOG FRAMES AND OTHER MACHINERY