manufactured by several companies in Chicago, Syracuse, Elgin, Ill.; Dowagiac, Mich., and Lititz, Pa. They are excellently suited to carrying to market good-sized loads of vegetables, fruit, dairy and barnyard produce weighing from 1,000 to 2,000 pounds, and for hauling back loads of feed, fertilizer, fencing and building materials, farm machinery, and so on. The high wheels give the axles and driving mechanism a good road clearance, and the construction is of a heavy and durable as well as simple character.

Numerous cases might be given of motor cars put to special service in connection with farming. In Maryland there is a high-class dairy farm where motor delivery wagons are used altogether to distribute milk among the consumers in the vicinity, and in Indianapolis a large milk company is using a 1½-ton and a 3-ton gasoline truck in the collection of milk from dairy farms within a radius of twenty-five miles of the city, which was formerly shipped by the interurban electric railways or by horse and wagon. In England a large produce grower sends his fresh vegetables to market in a huge motor van, the roof and tailboard of which, as well as the inside, are piled with green goods. These examples seem to foreshadow the time, not very distant, perhaps, when farmers will find it cheaper and more convenient to ship all of their farm products to market on motor trucks than to haul them with horses and wagons. Possibly the trucks will be owned by local express companies organized for the purpose, which will charge a reasonable price for haulage, so that it will pay the farmer better to keep his horses—if he needs any then—at work in the field, and he will not need to invest any capital in the motor trucks. Doubtless some of the transporting companies will use motor tractors, which will run over regular routes every morning and pick up a string of farm wagons loaded with produce, hauling them to market and back again for a fixed charge. A single tractor should be able to haul four or five such wagons over good roads.

In Connecticut a three-ton truck is regularly used for hauling grain and carrying all sorts of farm supplies and products for a 1,300-acre farm. This is one of the many fancy estates conducted in the East by wealthy owners largely as a personal hobby, yet at the same time as a profitable investment. The truck represents an outlay of \$5,000 and is kept in a special garage for work motor vehicles which are to be used extensively on the farm.

A ranch of several thousand acres in Montana is conducted entirely without horses, the plowing, sowing, cultivating, reaping, threshing, and hauling of the grain to the railroad being done by motor tractors and motor wagons. We have had the horseless street car for twenty years, the "horseless carriage" for ten, and now we have the horseless farm. May we hope some day for the horseless city?

While the foregoing examples are isolated cases and apply to farming on an extensive scale with ample capital, they point to great possibilities for the future use of self-propelled vehicles in farm work, utilizing gasoline, kerosene, or denatured alcohol as fuel. The farmer with a small acreage who would not be justified in buying a motor tractor for his own use, will be able to hire his plowing and threshing done by companies operating motor tractors, as for many years he

has had his threshing done by itinerant steam threshing outfits. And, incidentally, the work will be done cheaper, there will be no danger of fire from flying sparks, there will be little or no water to haul, and there will be fewer men to feed.

In this country, as well as in England and France, there are large companies that make a specialty of

AN AVERY FARM TRUCK HAULING SCRAP.

building small farm tractors for universal tractive and stationary power work. A company in Minneapolis makes an 8-horse-power tractor weighing 5,500 pounds for such work as operating hay presses, corn shellers, etc., and for drawing wagons and portable machines of this class on the road. In York, Pa., is another large company that makes motor tractors and traction engines in ten sizes, from 1,000 to 36,000 pounds in weight. The smallest is rated at 1½ to 2 horse-power and is intended for all sorts of farm work, such as hauling the stone-boat, churning, pumping, feed cutting, etc.

American motor tractors used for plowing and threshing usually develop from 12 to 35 horse-power and weigh from 5,000 to 20,000 pounds. They haul gang plows turning from two to eight furrows at a time. One of these—a 15-horse-power tractor built by the largest harvesting machinery company in the world—plowed 1.09 acres of "gumbo" soil with a three-furrow, 12-inch bottom plow in an hour and a quarter on a consumption of 1½ gallons of gasoline per acre at an international competition held in Winnipeg last July.

A "wagon tractor," built in Peoria by a great agricultural implement works for general utility

cents an acre for fuel. In a ten-hour day 7½ acres could be plowed for about \$3.25, not including labor.

This wagon tractor is a very interesting vehicle. It was designed particularly for farm purposes by men who are familiar with the peculiar requirements, and combines in one machine a truck for carrying loads on its own body, a tractor for drawing plows and other farm machinery, and a power plant for driving threshing machines, hay balers and other stationary machinery by belt. It will take the place of several teams and wagons on the farm.

Nowadays, on the farm as well as in the manufactory, it is necessary to do the largest amount of work in the shortest time in order to make an undertaking successful. This is recognized by the progressive farmer and farm machinery builders, and to a large extent the advantages of the motor car and motor tractor are appreciated by builders of farm wagons and buggies. Most of the leaders in these fields are now offering their customers a motor buggy, a motor car, a motor wagon, or a motor tractor.

The Modern Electric Automobile.

BY EMIL GRUENFELDT, M.E., E.E.

The heavy, cumbersome electric cab or brougham of earlier days has cleared the field for the light run-about, victoria, or interior-driven coupé. Less weight means more speed and a greater mileage radius. It was looked upon as a great performance when one of the earlier types of electric automobiles traveled forty miles on a single charge of the battery at a comparatively low speed. The modern electric automobile will negotiate about twice the distance at

a much greater speed. The most vital components of an electric automobile are the motor and controller, two parts which are of different design on about every other make. For its various advantages, the series-wound motor has outclassed its rival of the earlier days, the compound motor. The series-wound motor, if properly designed, will do its work for three hundred and sixty-five days in the year without requiring any attention. The most desirable motor is not that which tends to drive a car up a hill at a comparatively high speed. A heavy battery discharge is thus entailed, which is of course very detrimental to the battery. Of two cars traveling at the same speed on the level, that one will travel the faster on a grade, whose controller was not changed. The motor of this faster

WITH A REEL OF WIRE FENCING AND A BOX OF TOOLS ON THE REAR DECK THE PASTURE FENCE IS QUICKLY REPAIRED.

car is designed for a smaller increase of torque in proportion to the decrease of the speed. Even if this difference in speed is very small, say one-half mile an hour, the faster car will have to pay dearly for it, in current as well as in decrease of mileage radius and in battery wear. The good designer will find a middle way. He will strive for the highest battery efficiency. It is by no means difficult to construct a

fast electric, as the power is unlimited for a short distance. The art is to apply the power at disposal in the most all-around satisfactory way, and to design a carriage which is reliable and cheap to maintain.

In the line of various controllers, the drum type for good reasons seems to have grown into great favor. The various speed changes can be obtained without arcing or burning, and a gradual increase of speed is effected from step to step with a small increase of

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HALF A DOZEN CANS OF MILK ARE TAKEN TO THE CREAMERY AND THE EMPTY CANS BROUGHT BACK.

purposes in the field and on the road, was tested at the same trials. Coupled to a two-furrow 14-inch gang plow, it turned over 1.06 acres in 1 hour 25 minutes on a consumption equivalent to 3.36 gallons of gasoline per acre. This would amount to about 50

INTERNATIONAL HARVESTER FARMER'S WAGON,

THE KNOBS WILL STOP YOUR SKIDDING

THE MORGAN & WRIGHT NOBBY TREAD

a new non-skid tire designed and made by Morgan & Wright, makers of "Good Tires." As a safeguard against skidding and drive-slipping, it has never been approached in non-skid tire construction.

The big, thick knobs, made of the toughest rubber it is possible to produce, grip the road like a magnet and prevent side slips or drive slips even on wet asphalt pavements or roads covered with snow or ice. It has passed the experimental stage. Reports from all sections show that not only in effectiveness, but also in wearing quality it is vastly superior to the existing styles of non-skid tires. The broad knobs expose nearly as much surface to the wear of the road as a plain tread, and consequently wear down little if any faster. Made of a white rubber stock, it is by odds the "classiest" looking tire on the market, and will add an up-to-the-minute finish to any car to which it is equipped.

MORGAN & WRIGHT NOBBY TREAD TIRE

MORGAN & WRIGHT, DETROIT

BRANCHES, AGENCIES OR DEALERS EVERYWHERE

keeping prices down, there is little doubt that the American maker will sooner or later figure in the foreign trade. This is particularly true in connection with the small, medium-priced car, a field that has been neglected by the foreigners. With the rapid growth of the business there have been developed many new captains of industry, who as pioneers have blazed the way for motor-car trade, and who are certain to be important factors in future industrial life.

The Modern Electric Automobile. (Continued from page 51.)

current consumption. This arrangement is necessary to keep any excessive rush of current at any time away from the battery. Nothing is more detrimental to the capacity and the life of the battery. A rapid increase of current flow and speed from step to step will result in a jerking action in the whole driving mechanism, which of course means rapid wear and possible breakage of the driving parts. It is easier to break a string with a short jerk than with an even, smooth pull.

The limited power carried in one charge of the battery has forced the designer of electric carriages to avoid as far as possible all losses due to friction in the method of transmission of the power from the motor to the wheels as well as in the bearings. The high-speed motor, with its advantage of light weight and high efficiency in starting and in climbing hills, necessitates, in the most approved methods of construction, a double reduction of speed. This means that the motive power is first transmitted with a reduction of speed to a countershaft, and then to the rear axle. The first reduction of the countershaft is accomplished in different ways and with varying success. The earlier carriages used metal spur gears for this purpose, but they proved to be unsatisfactory on account of their noisy running and great loss of power. It may be mentioned here that where

there is noise there is friction, and consequently where there is friction there is loss of power. The next step of improvement was to make the one gear of compressed rawhide. A little less noise in running resulted. But this construction was still far from being perfect. After passing through the stages of worm and arrow-toothed gears, a perfect transmission was obtained when the Renold silent chain was introduced. This chain is self-adjustable to pitch after wear. In flexibility and high efficiency, it is an ideal, high-speed transmission device. It is found to-day on every high-grade electric car. If kept in proper alignment and well adjusted, the life of this chain is indefinite. To receive the best service, it must be dust-proof, incased, and kept well lubricated.

The power is transmitted from countershaft to the rear wheels on all up-to-date machines by means of roller chains or through a shaft and bevel gears. The advantage of one type over the other has been much disputed. The greatest objection to the roller chains is their noisy running, their rapid wear, their exposure to dirt and dust, and their loss in efficiency after wear. Some reasons for the superiority of the shaft and bevel gear transmission are its quietness, its cleanliness, its long life, and its increased efficiency after use. Its durability is due to the fact that the bevel gears run permanently in oil and that they are incased. Moreover, the shaft drive does not require any adjustment, and when well designed, all parts of the running gear and power plant will stay in absolute alignment. The necessary adjustment of the double chain drive will soon create a variation in the distance from the front to the rear axle on both sides; for two chains will never stretch alike. This disadvantage will affect the steering, decrease the life of the tires, and result in a loss of power. If the chain sprockets are

not in proper alignment after adjustment the chains will rub sideways on the sprockets, which will, of course, shorten the life of the transmission and result in a loss of efficiency.

It would be very interesting to measure the distance of both axles on either side of double chain-driven cars after they have been in service in the hands of the average driver and under the care of the average garage for several months to find out if the axles are still parallel. Absence of friction is an absolutely necessary factor in the construction of electric automobiles. For this reason the proper type of bearings must be applied to the motor, countershaft, and wheels. The ball bearing, the highest achievement in bearing construction, has proven to be superior to any other type, and will be found to-day in any high-grade automobile. Once properly packed with grease this bearing will not require any attention for several thousand miles; if proper sizes for the load to be carried are selected, no wear can be noticed.

Every electric carriage should be equipped with reliable brakes. It is important that they should stop the car going forward as well as backward. It is not the number of brakes with which a car is equipped, but their efficiency, which insures safety. Most modern cars are equipped with one of two types; namely, the external brake in which a steel band surrounds the drum either on the motor shaft or on the rear wheels, or the internal expanding brake attached to the rear wheels, which is commonly used and generally preferred. In this construction two brake shoes are fixed inside a drum. A small movement of the brake lever will cause the brake shoes to open out against the inside surface of the drum. The braking action should be applied at the rear wheels. All brakes attached to the motor, if used frequently, are detrimental to the motor and the transmission system. For this

reason also, the electric brake, which seemed in older days to be inseparable from any electric vehicle, is condemned by the modern designer of electric conveyances. Even on the heavy electric street car it had to give room, on this account, to the air brake. In many brakes the shoes or bands are operated through flexible steel cords, which is not the best arrangement. A system of steel rods is to be preferred. In case two brakes are operated by a lever, a balancing bar should be inserted in the system to insure equal pressure on both brakes.

Tires influence the performance of an electric automobile more than may be imagined. Various designs of tires show a variation of up to fifty per cent in efficiency, so that the speed per single charge of the battery is affected. Special points to be borne in mind in the care of pneumatic tires are that rust as well as oil is very detrimental to them, and that it is necessary to keep tires well inflated.

If the storage battery of a few years ago be compared with the up-to-date battery, it will be found that a very much decreased weight with a large increase in capacity and durability has been obtained.

The various wire connections on an electric car should be laid with care, and the wire sizes should be large enough to carry the heaviest possible loads without loss of power. As far as possible, all leads should be carried directly from the battery to the controller, and then to the motor, and all connections should be tight and securely locked. One common fault in early cars was the loose hanging wires running in different directions, without any attempt at a methodical arrangement. Good insulation is necessary. Because it is able to resist acid, weather, and mechanical strain, rubber of good quality and sufficient size has proven to be the best material for this purpose.