The Small Motor on the Farm

What it has Contributed to the Farmer's Comfort

By L. W. Ellis

A HUNDRED years ago the production of the necessities of life kept four families out of five on the farm, and those four barely supported the fifth by their surplus products. Choice of occupations was necessarily limited. Since the invention of the steam engine, the manufacture of countless necessities has been transferred from farm to factory. The steam engine has made possible the wonderful development of our land and water transportation system. It has fostered the growth of our great centers of population, increasing the opportunities for employment away from the farm. The transfer of manufacturing to the city and the development of wonderfully efficient horse-drawn field machinery for crop production released millions of workers from the isolated life of the country. In consequence we have had for a generation the problem of making farm life more attractive.

It has remained for the engineer to accomplish what the agriculturist failed to do, and, naturally enough, by the same methods by which he made life away from the farm attractive. He is establishing easy means of communication and transport, devising conveniences for the farm home, and, most of all, he is introducing mechanical power to take from human shoulders the monotonous daily tasks that cannot be shifted to those of the animal. The agricultural world is awakening to the stunning fact that, after all, the farm is an engineering proposition. Production, to be efficient, must be organized on the same lines as in other great industries. The small motor is only the beginning of a wonderful development in agricultural engineering, and has greater significance than the importance of present installations would indicate. It is significant of the tendency to intensify agriculture by applying more power to each acre and carrying processes farther on the farm. It means the elimination of drudgery, the saving of unnecessary human labor, which is conservation of the highest type. It means the opportunity for exercise of mental rather than physical strength, the development of broader intelligence on the part of our farmers, with direct benefit to those who must depend upon the farmer's efficiency for their daily bread.

Electrical machinery has gone through wonderful development, and competition in commercial fields has at last brought the farm to the manufacturer's attention as an unworked source of trade. One of the papers at a recent meeting of the American Society of Agricultural Engineers was read by the representative of a large electrical concern, the title being, "The Promise of an Electrical Agriculture." The resulting discussion developed the fact that both engine and electrical manufacturers are looking to the farm for their greatest volume of business in the near future.

Without dwelling further on the economic phases of the question, we may pass to a consideration of some of the many adaptations of internal combustion engines and electrical motors to farm purposes. The discussion will be confined to those operations involving the saving of hand labor, the use of mechanical power in field work being a vast subject in itself.

The uses of the gasoline or kerosene engine on the farm are almost without number, but only the exceptional farmer has established a complete power plant. Pumping water by hand has long been regarded as impracticable, and in regions of unbroken topography the windmill has been generally unreliable. The latter's frequent failure in the summer, the time of greatest consumption, has led to a surprising shift to the small engine for pumping purposes.

In general the needs for water are for fire protection, sanitation, irrigation and consumption by household and stock. By the aid of the engine the farmer may have a better water supply than his city relatives. For instance, an elevated storage tank will give gravity pressure for faucets or hydrants all over the farmstead, and the newer pneumatic tank, underground, gives both pressure and insurance against freezing. In the latter the engine may be used to pump either air or water into the tank up to a pressure of from 15 to 75 pounds per square inch. It is now possible, by means of an engine, a compressed air tank and a submerged pump, to have abundant water direct from the well by simply turning a cock in the kitchen. The pump, located at least six feet under the water, may be started by turning the faucet, the air supplying power for operating the pump. A surprisingly large percentage of farm houses are being equipped with modern sanitary conveniences which contribute to the health and comfort of the family.

The engine has solved the problem of irrigation in

many square miles of semi-arid territory where large projects are not possible or have been delayed. As a rule the engines used are of larger size than those used for general farm purposes, but in numberless instances the engines of from three to ten horse-power has proved the salvation of the farmer by supplying water for at least a small field.

Water can often be found at a shallow depth in dry runs or by boring. A five horse-power engine will raise 500 gallons per minute from a depth of twenty feet. Even in the favored Cornbelt and the East, the engine is being called on to keep crops forging ahead through the customary summer drouth.

Too often the only use of the small engine is for pumping water, or grinding feed, or some other one task. In contrast the writer has in mind a two-story power house on a side hill, visited over three years ago. The engine and pump are in the basement. Overhead is a line shaft, to which are attached at will the cream separator and churn, the washing machine (the boys do the washing and like it, because there is some inspiration in the chug and fuss of the engine), the corn sheller, fanning mill, feed grinder and grindstone. To all intents and purposes the building is a small industrial plant. There the farm office is located, the farm business transacted, the bulk of the farm stores kept, and many of the important processes of the farm carried on. All is system like that of the factory. There is activity without drudgery, the condition in any occupation which begets enthusiastic service.

Out in the dairy barn one clean, well-paid, trained dairy assistant now does the work of two slovenly farm hands openly rebellious at the tiresome job of milking. All that the farmer saves in money, perhaps, is the keep of one man, but in freedom from labor troubles and in general improvement of dairy conditions he gains in reputation and satisfaction of mind. The vacuum milking machine is responsible, with a gasoline engine off at the dairy house energetically minding its business of running the vacuum pump and the cream separator. Ten to fifteen cows per man per hour is the new standard of capacity, with far less work and dirt. The vacuum cleaning principle is applied to the cows by a slight addition to the equipment. All the dirt, loose hair and other foreign matter can be drawn off into a dust collector and removed. By the ordinary process of currying and brushing, these sources of contamination are stirred up to fly about the stable and settle upon the utensils. In dairies of fifty cows or less an engine of one and one-half horse-power is sufficiently powerful to run the four to six milkers usually attached and to handle other dairy machinery besides.

The livestock is rid of its surplus of old hair neatly and rapidly through the agency of a power clipping machine and a very small engine. The engine may assist in spraying the cattle for parasites, whitewashing and spraying the interior of the barn as a preventive measure. Spraying now extends to the orchard also, where insect and fungus enemies are successfully combated.

Filling the silo has rather grown beyond the limits of hand work, though it started in the same class with the work of chopping roots, corn, grasses, etc., by hand. All this work, heavy or light, may now be done by the gasoline engine, and the number of silos has increased in thirty years from less than one hundred to many thousands. One of the accompanying illustrations shows an engine of about twelve or fifteen brake horse-power handling close to seventy-five tons of corn fodder per day on ten to twelve gallons of gasoline.

The internal combustion engine for such work must have an excess over the average power requirements, as the load is irregular and the speed must be kept up in order to obtain efficient results from the ensilage cutter. On this account a heavy fly-wheel is added to equalize the motion of the engine. Again, some manufacturers, following the lead of the builders of large gas engines for heavy duty, are adopting the volume, or throttling, governor in place of the hit-and-miss type. In the latter the explosions are occasionally "cut out" by automatic action of the governor when the speed increases above the normal, to be resumed again when the absence of power impulses causes the speed to drop below normal. The throttling governor admits a charge for each cycle, proportioning it each time to the needs of the load. It is, therefore, slightly less economical on light loads than the hit-and-miss type, but for the heavy, irregular work of shredding corn, filling the silo, sawing wood, etc., it can be depended on to furnish steadier power.

"Bucking wood" no longer has its terrors for the farm boy. If the farm cannot afford the investment in a saw to go with the gasoline engine, there is very apt to be a neighborhood saw. Wood is not a perishable product, however, and farmers are often content to wait until the owner of a large outfit puts in an appearance and does the work on a custom basis.

One of the most exhausting chores in connection with the harvesting of the corn crop is shoveling off the load after a day of ten or twelve hours in the field. Now a two-horse-power gasoline engine, attached to a portable elevator, will empty a thirty-bushel load of ear corn into a car, corn crib or granary in from three to six minutes. The same is true to some extent of the small grain crops. Quite often both elevator and engine are mounted on the same truck, and in connection with the large threshing outfits this combination saves labor that is hard to get just at that time. The wagon is driven into position, the front wheels elevated and the rear end gate removed. The grain falls into the hopper, is elevated by an endless conveyor and delivered by a flexible spout at heights practically impossible by hand. The engine has therefore made it possible to build granaries and corn cribs higher, at a considerable saving in initial expense per unit of storage space.

On farms where heavy machinery, portable buildings, etc., have to be moved frequently from place to place, the portable gasoline engine equipped with a winch and cable is often indispensable. A five-horse-power engine may occasionally be seen putting a fifteen-ton tractor into a space on a storage floor which would not withstand the combination of weight and vibration produced by running the tractor under its own power.

It has been conclusively demonstrated that the horse is a more flexible traction power unit than the gasoline engine. He may be coupled up in teams of varying size, and in a pinch can pull to many times his normal capacity. At the same time, for driving rotary mechanism of fairly constant resistance, the engine has a great advantage over the horse in endurance. This is further emphasized by the loss entailed in transforming the linear motion of the animal's forward progress into the rotary motion of the machine. While a school of engineers in France has been arguing that the ideal farm machine should use horses for propelling it and the engine for performing its effective work, Yankee ingenuity has perfected the combination. From mounting a small stationary engine upon the frame of a grain binder, which was done repeatedly by inventive farmers before manufacturers grasped the possibility, we have now come to an engine mounted on wheels and connected by a shaft and universal joint to the driving shaft of the harvester. This outfit goes merrily up hill and down dale with two horses where four or five were formerly employed. It is especially adaptable to cutting rice or grain on soft ground where the traction wheel of the binder could not grip the surface firmly enough to transmit the required power.

To the average farmer electricity is a mysterious agent, to be gingerly dealt with. Up to date the widest use of electricity on the farm is for lighting and for the light tasks about the house. Current for general power uses has usually proved more costly than power derived from the gasoline engine, and the kerosene engine has even further increased the handicap. Moreover, the engine, as a self-contained and easily portable unit, is much more convenient for use at different points. In isolated cases, however, a small stream has been harnessed, and even at a considerable cost for electrical equipment, been made to furnish cheaper and more convenient power than the engine.

Improvement in the storage battery has widened the use of gasoline-electric systems. A two-horse-power engine will furnish a horse-power hour for 0.15 gallon of gasoline on full load and on 0.2 gallon at half load. As many tasks require less than full load, the storage battery has been made to economize by taking up the surplus power. On the average farm it is seldom necessary to run the engine simply to charge the battery, hence the lights may be said to cost little or nothing outside of the cost of installation and the periodical restoration of the battery electrodes. The storage battery is a great convenience. It is a necessity with the hit-and-miss governed engine if a clear, steady light is to be had. Some types of engines with throttling governor control have proved very satisfactory when coupled direct to generators. This connection requires, of course, that the engine be run as long as lights are required, and

unless some such work as pumping necessitates running the engine at night, the outfit would probably be useful only on large farms where a number of buildings are to be lighted.

Low voltage systems are commonly offered to the farmer on account of safety, simplicity and low operating cost. The improvement of the low voltage tungsten lamps, consuming about one-third the current required to operate the ordinary carbon filament lamp, has made it possible to reduce the size and cost of installations, especially in the matter of storage batteries. The fifteen-light plant is probably the most popular, as more than that number are seldom burned at one time. With this outfit it is possible to wire for twenty or thirty lights, and burn the entire number by running the engine and dynamos and taking current from the battery at the same time. The fifteen-light outfit requires about one-third horse-power and the thirty-light about three-fourths horse-power, but less than a two-horse-power engine is seldom installed. The total cost of engine, generator, storage battery, switchboard, wiring, fixtures and lamps, for a fifteen-light, thirteen-volt outfit is around \$400. The light will cost in the neighborhood of one one-hundredth of a cent per candle-power hour. For installations covering considerable area it is advisable to use a higher voltage, i. e., twenty-five or thirty.

With the development of interurban railways and long-distance transmission lines it is frequently possible to obtain current from the central station at lower cost than from individual plants. Communities are to be found where the use of electricity for light and power is practically universal, and com-

munity central stations are developing in the same manner as did farmers' telephone lines a decade ago. The installation of low voltage apparatus for individual plants requires radical change in equipment when central station power is finally obtained.

The small electric motor is especially convenient about the farm house, attached to a fan, a flat iron, a churn or a washing machine, for the housewife has but to turn a switch to secure relief from heat and weariness. The electric range and chafing dish can hardly be said to be in general use, but the vacuum cleaner is coming into its own. For \$100 the mistress of the household is equipped to clean carpets, floors, upholstering, drapery, etc., by suction at a cost of three cents per hour. The blowing attachment chases dust from inaccessible places. The outfit may be used even for the lady's massage and drying her hair. A motor of one-sixth horse-power furnishes power for all.

A supply of soft water under pressure, independent of the farm supply, can readily be obtained from a cistern, a pneumatic tank, a rotary pump and a motor of one-fourth horse-power. Convenience rather than cheapness has been the means of popularizing the electric motor, and it is only natural that it should appear oftener in the home than in the producing end of the farm.

A friend of the writer's even applied electricity to the farm fence. He drove 2-inch $\times$ 2-inch sticks about four rods apart surrounding a pasture field and strung two No. 15 wires thereon, properly insulated. As a starter he connected up a tiny dynamo, driven by water power, with his fence wires. By carefully introducing the various animals to the fence before

turning them into the pasture, he educated several to give it a wide berth. The others, however, showed a supreme disregard for the fence, and after the most carefully educated mule, in a panic, took out several panels the inventor quit in disgust.

This discussion has hardly covered all the farm uses of the small internal combustion engine and the electric motor. Enough has been said, however, to justify the statement that one of the greatest present needs of the farm is a comprehensive inquiry into the subject of power installations. These motors are working revolutionary changes in the social and economic status of the farm laborer. But there are no state or national publications on farm power questions to compare with the concise, helpful series on every other topic.

The writer has long advocated the need of a branch devoted to agricultural engineering in the United States Department of Agriculture. On account of the breadth of the subject the State colleges do not as a rule have the necessary resources to investigate all phases of agricultural engineering, and under the present organization the subject of farm power can receive but little attention. The interests of manufacturer and purchaser are identical. It is gratifying to note that the National Gas and Gasoline Engine Trades Association, representing the makers of internal combustion engines and accessories, has joined hands with the American Society of Agricultural Engineers, representing the college men and farm machinery manufacturers, to urge upon Congress the organization of a Bureau of Agricultural Engineering at Washington to cope with the situation which is so rapidly assuming importance.

Internal combustion engine fighting the codling moth.

Farm pump engine taking the place of a blown-down windmill.

Mechanical horse clipper in use.

Milking cows with hydraulic apparatus.

Gasoline engine employed in irrigation.

A gasoline engine "bucking wood."

THE USEFULNESS OF THE SMALL MOTOR