THE MODERN FARMER'S TIRELESS HORSE.

BY FRANK C. PERKINS.

The remarkable development of the gasoline and kerosene motor during the past few years has resulted in its use on American farms to a great extent for pumping water, sawing wood, and other service about the farm, where a stationary motor can be utilized to advantage. This modern labor-saving device has been successfully applied to traction service on the farm, and has taken the place of both men and animals.

The gasoline traction engine for plowing marks one of the latest steps in the evolution of farming during the past several decades. Tractors are now extensively employed, not only for breaking the land, but also for double disking, seeding, and cutting grain.

It is well known that the cultivation of the large farms so common in the great American wheat belt, lying west of the Mississippi River, requires large numbers of men and horses. The up-to-date farmers have turned to the traction engine to take the place of men and horses in these large farming projects. The first traction engines used for plowing were the ordinary steam threshing engines, built primarily for belt service, and their use involved numerous expensive breakages and many discouragements. Consequently, the traction engine has been made more substantial. Steel or semi-steel gearing has been substituted for cast iron, with the result that the steam plowing engine of to-day is much more massive in construction than the threshing engine. In fact, the service is so severe, that no engine can be successfully used for this purpose unless especially designed for it. In other words, no ordinary threshing engine can be a successful plowing engine. On the other hand, the plowing engine is most successful as a threshing engine.

Although the steam plowing engine has achieved success, it is hampered by many inherent difficulties. In the first place, it requires a considerable force of men and horses to keep it in operation and to supply it with fuel and water. It so happens that where traction engine plowing is most desirable, fuel is high priced, and water is often unfit for boiler uses, and moreover has to be hauled considerable distances. It is not uncommon to find steam plowing outfits at work where three four-horse teams are required to keep them supplied with fuel and water. Localities are unknown where two teams are not required for this purpose. The engines stand idle at least twenty per cent of the time, taking on coal and water.

Moreover, the steam plowing engine is hampered by its excessive weight. It is not uncommon to find such engines whose working weights are 36,000 to 40,000 pounds. There are large areas of territory where such weights cannot be transported over fields without driving wheels of excessive width, which make it difficult for the engines to turn and maneuver.

It has been held that a gasoline traction engine of rugged and substantial construction would be the ideal plowing engine, because it would be free from the defects mentioned.

The gasoline traction engine shown in the illustration is rated at 22 actual traction horse-power. Hence, it is not as large as many steam plowing engines. Still it is large enough for most farmers. Compared with steam plowing engines of the same rating, it is much more substantially constructed, and yet weighs only 19,000 pounds. It uses cheap kerosene or gasoline for fuel, the supply tank holding enough to last for a day's run. The motor is air cooled, and hence dispenses with tank wagon and teams.

A traction engine uses up much of the power in merely moving itself over the ground. If the ground is soft and the cleats sink in deeply, it may use more than half its power for this purpose. The gasoline engine described is capable of continuously developing 40 horse-power, and on firm, level footing it will use up about 18 horse-power in propelling itself over the ground, leaving the available tractive effort of the engine about 22 horse-power. If the footing is quite soft, the available tractive power may be cut down to 18 horse-power. On the whole, the engine's tractive power is equal to that which can be continuously rendered by eighteen ordinary horses on comparatively level ground.

Everyone knows that there are two kinds of engine gang plows in common use, the moldboard and the disk. Each has some advantage not possessed by the other. In tough sod the moldboard plow is the only one that can be used for breaking. In sticky or "gumbo" soil the disk plow is the best for stubble plowing. In dry, hard soils, such as are found in most of the semi-arid regions, the disk plow is equally suitable for breaking or stubble plowing. It is generally admitted that in any soil suitable for a disk plow, a wider furrow can be cut with the same effort when applied to disk plows than to moldboard plows. In such soils, therefore, an engine with disk plows can turn more acres per day than if using mold-board plows. If each disk cuts a furrow only 8 or 10 inches wide and 5 or 6 inches deep, the ground will be plowed equally as well. On ground where there are more or

less of hidden stones, the disk plow is the safest one to put behind an engine.

No doubt the condition of the soil and the depth of plowing also materially affect the draft of plows. It may take one-third more power to pull a plow through heavy soil that is almost dry, than if it were thoroughly moist. On heavy soils the draft increases out of all proportion to the depth of plowing.

Under average conditions, six 14-inch moldboard plows make a suitable load. Where disk plows are used, from eight to fourteen disks may be successfully operated, according to local conditions.

Regarding the amount of ground that can be plowed per day with a gasoline engine, the following calculation is said to be correct: In one mile there are 5,280 feet. A 14-inch plow bottom, turning 14 inches of soil, in cutting one mile will turn or plow 6,160 square feet. At a speed of two miles per hour the amount of ground turned by one 14-inch plow will be 12,320 square feet. As there are 43,560 square feet in one acre, the amount plowed by one plow (cutting 14 inches) in one hour will be 0.283 of an acre, or for a day of ten hours 2.83 acres. On this theory, four plows of the width mentioned in ten hours will plow about 12 acres; six plows, 17 acres; eight plows, 23 acres. It is a fact, however, that the ordinary day of the farmer is much longer than ten hours. Assuming that it is twelve hours, add to the above about twenty per cent.

The gasoline engine is speeded to run 2 1/3 miles per hour on hard ground. On soft ground there is some slippage of the traction wheels, and some time is lost in turning at the ends of lands, stops for oiling, adjusting plows, etc., so that the average rate of travel will generally be about 2 miles per hour, or 20 miles per day of ten hours.

In order to demonstrate clearly the superior economy of the gasoline plowing engine, an estimate of the daily operating expenses of the two types of engine plowing outfits has been prepared, both of the same size, and each presumably capable of plowing the same number of acres daily. The prices are based upon average North Dakota conditions, and 40 gallons, the maximum consumption of fuel for ten hours, has been used as a basis. The results are as follows:

Steam Traction Engine.	
1 ton Hocking Valley coal.....	\$7.50
Licensed engineer, who also steers.....	5.00
Fireman, who also handles plows.....	2.00
Water and coal hauling, 2 men 2 teams	8.00
Board of 4 men at 50 cents per day....	2.00
Board of 4 horses at 25 cents per day..	1.00
Lubricating oil	.50
Total daily operating expenses.....	\$26.00
Kerosene or gasoline plowing outfit per ten hours is as follows:	
40 gallons kerosene at 13 cents.....	\$5.20
Engineer, who also steers.....	4.00
Plowman	2.00
Board of 2 men at 50 cents per day....	1.00
Lubricating oil.....	.50
Total daily operating expenses.....	\$12.70
It is maintained that the saving in favor of the internal combustion engine is \$13.30 per day.	

The Current Supplement.

The current SUPPLEMENT, No. 1695, opens with a short treatise on the boomerang and how to throw it. The boomerang is not discussed from a scientific point of view, but the personal experience of the writer is given—an experience which will undoubtedly be helpful to those who may take any interest in this strange weapon. William H. Booth presents the chief points of the difference between gas and steam engines. In the twentieth installment of his "Elements of Electrical Engineering," Prof. A. E. Watson discusses alternating-current measuring instruments and recording wattmeters. Madame Curie's excellent paper on "Modern Theories of Electricity and Matter" is concluded. "The Sixth Sense of Fishes" is the title of an article by N. Schiller-Tietz, in which the true purpose of the lateral organs of a fish is popularly discussed. Dr. Arthur Stieler reviews the various efforts which have been made to restore the Venus of Milo correctly. Illustrations of the various restorations accompany the text. "The Unity of Life" is the title of a thoughtful article in which respiration in plants and synthetic assimilation in animals are clearly discussed. John C. Sparks sets forth, with as little confusing technical terms and phrases as possible, the results and significance of a biological study of the effect of continued low temperatures on the germ life remaining in ice made from impure water. The excellent and thorough paper by J. Pigg on "Automatic Cab-signaling Devices on Locomotives" is continued.

A French system for the employment of alternating instead of continuous currents in telegraphy has recently been devised. This system permits of the use of twelve instruments on a single wire.

AN INCANDESCENT LAMP WITHOUT A VACUUM.

(Concluded from page 454.)

filament does not further affect the lamp than to diminish its candle-power proportionately. Now helion is able to withstand higher temperatures and is found to possess greater radiating power under the passage of an electric current than the carbon filament, whose disintegration with use, as seen in the blackening of the bulb or complete failure due to volatilization with any increase of voltage above a critical point, are most familiar. The filaments of the helion lamp, on the other hand, can be worked with a satisfactory life when the filament is at a temperature of from 1,900 deg. C. to 2,000 deg. C. They have also successfully withstood a temperature of over 3,000 deg. C. at atmospheric pressure, according to measurements made with a Fèry pyrometer. In the evolution of the helion lamp, Messrs. Parker and Clark, the inventors, have gradually reduced the amount of carbon, so that their filaments to-day, so far as their surface is concerned, are entirely composed of helion. These filaments are made by taking ordinary cellulose carbon filaments and then "flashing" them in a special mixture of gases, so that the carbon is coated with many times its volume of helion. This surface may afterward become transformed into silicon oxide and silicon nitride by heating in an atmosphere of oxygen and nitrogen. Although the oxide may be volatilized at the highest temperatures when the filament is worked in a vacuum, the nitride is perfectly stable and withstands the heat, thus neutralizing the effect of the oxide. It is thought that this coating of oxide and nitride acts to protect the filament, and enables it to burn with high efficiency even in air. The comparatively large cross section obtained with such a filament gives to it great strength and rigidity, while at the same time it maintains a high resistance to the passage of the current. This of course makes for economy, since at a temperature of about 1,600 deg. C., the ordinary temperature of a carbon filament, the energy consumed is 3 1/2 watts per candle as compared with 2 1/2 watts for helion. Furthermore, to absorb 110 volts, a filament but two inches in length is required, which not only is much shorter than the metallic filaments, but even than those of carbon. A strong and durable filament capable of carrying 1/2 ampere is but 0.01 of an inch in diameter. It is this property of the filaments that makes it possible to use them in parallel, as has been stated, and the latest type of lamp is arranged for 40 candle-power with four separate filaments. This not only makes a most useful distribution of light, but affords a lamp that has a long life, not only in its original condition, but with diminished candle-power as the filaments burn out or break. In the four-filament lamps there is a central terminal from one of the leading-in wires, to which the filaments are connected on one side, while on the other they are connected with the corresponding leading-in wire. The efficiency of the helion lamp, realized in laboratory tests, ranges from 1 1/2 to 2 watts per candle in the case of the 10-candle-power lamps to 1 1/4 and 1 1/2 watts for the 20-candle-power lamps, and 1 watt for those of 40 candle-power. An experimental 1-watt lamp has been burnt over 700 hours, and the helion laboratory is now developing commercial methods and machinery for their manufacture.

The ability of these incandescent lamps to be made with bulbs containing air at atmospheric pressure has a particular application to battleships, where the discharge of the great guns is often sufficient to impair the incandescent lights throughout the ship. In fact, it has been stated that on certain of the Japanese battleships in the engagements of the Russo-Japanese war, the incandescent lamps were put out of action within the first five minutes of firing, and the necessary illumination had to be furnished by oil battle lanterns and the burning of oil-soaked waste. With filaments mounted in bulbs at atmospheric pressure, the lamps are much less likely to be broken by the sudden and violent pressure due to the discharge of the large guns, while the helion filaments, being much more rigid and stronger, can withstand the shock. The same conditions are to be found in land fortifications, where, even now, any possible failure of the incandescent lamps in the batteries is provided for by oil or arc lights, with suitable reflectors to illuminate the mechanism of the guns and mortars.

Lemoine, who induced Sir Julius Wernher of the De Beers Mining Company to give him \$320,000 for an alleged process of making diamonds from carbon and sugar, and who was subsequently brought to book in the French courts by his victim, is a fugitive from justice. The French court gave him a certain time in which to substantiate his claim that he was really able to make diamonds. One day before the expiration of the stipulated time, Lemoine fled. A sealed envelope which Lemoine claimed contained the secret of his process, and which was intrusted to court, was opened and found to contain merely a worthless formula.

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The Gasoline Traction Engine Hauling a Disk Plow.

A Gang Plow Hauled by a Gasoline Traction Engine.

THE TIRELESS MODERN FARM-HORSE AT WORK IN THE FIELD.—[See page 458.]