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## Power for Cultivation and Haulage on the Farm

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### The Design of a General- Purpose Tractor

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field under practical conditions the problems of soil tilth, on which developments of the above nature must be based.

In this brief review of the subject the endeavour has been made to compare and contrast horse and tractor work on the basis of actual performance alone, and the evidence leads to the definite conclusion that mechanical power will, on its merits, play an increasing part in our farming operations.

There are two other factors that will in all probability accelerate this process.

The first is : market for draught horses is rapidly diminishing with the greatly increased use of motor transport, and we seem to be within reasonable distance of the time when the farming community itself will be the only buyers of horses.

The second point is perhaps more debatable, but one wonders whether the traditional method of meeting bad times by taking land out of cultivation and laying it down to grass is going to survive the great development of the cheap imported-meat trade. Farmers met the competition of imported wheat in the 'seventies by laying land down to grass; they may be compelled to meet the competition of imported meat by maintaining their land in arable crops, in which prominence will be given to semi-market-garden crops, for which there is, throughout the country, a large and increasing demand.

## THE DESIGN OF A GENERAL-PURPOSE TRACTOR

BY H. G. BURFORD, M.I.A.E., M.I.Mech.E.

*S. Hampstead*

BEFORE dealing with details bearing on the subject of the "General-Purpose Tractor," I think it would be of value to review the development of the Tractor industry that has been steadily taking place during the last two or three years. Unfortunately for all interested, the agricultural industry in this country has gone through very difficult times, and the general position is one of great anxiety. Whilst countries on the Continent are steadily developing the use of the tractor—covering very wide fields of activity, and absorbing them in large numbers—the home requirements are very small and, again unfortunately, supplied very largely from foreign factories. This state of affairs is very regrettable, and when the demand comes from the British agriculturist—as it is bound to do—Britain will

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find great difficulty in meeting that demand. In my opinion—which has not changed for many years—the way to restore prosperity to the agricultural industry must be by the employment of mechanized power for every possible requirement on the farm. This opinion is based on the first and important question of *time*, and the necessity—owing to the various climatic changes—of using every available opportunity for intensive cultivation.

The manufacturers of tractors in the past have been met always with the question of producing tractors at a low price, and in many cases to meet these conditions it has necessitated the employment of unsuitable material, with results quite frequently very unsatisfactory to all concerned.

It has been found by experience that to give satisfaction it is imperative that material of the highest quality only should be used.

Assuming that the tractor of to-day embodies high-grade material, with all the advantages of heat treatment and the results of steel research derived from experience gained both during the War and after; and remembering that many manufacturers of tractors are also manufacturers of cars and commercial vehicles, and with their extensive production methods and modern machinery can bring into the tractor business their experience, thereby reducing the cost to a minimum; whilst other firms specializing on the production of tractors in specially equipped shops also have practical experience in productive methods in other branches of their business; based on these facts, the agriculturist, when purchasing a tractor, can be assured that all the ingenuity and skill of the engineer, both as to material and workmanship, are embodied in their latest products.

The question of maintenance and upkeep is being separately dealt with by Mr Watson, so that my remarks will be brief. The extreme conditions under which the farm tractor has to perform its work calls for care and attention from the hands of the user: cleanliness, care of entire lubrication system, periodical inspection and adjustment of all wearing parts, careful attention to all the instructions issued by the manufacturer, and good housing accommodation. Neglect of all or any of these points will be costly, and the results will be dissatisfaction to both user and manufacturer.

Practical experience and study have proved that the worst enemies to the agricultural tractor are dust, grit and lack of attention. Manufacturers are giving great care and study to eliminate the foreign matter from the engine. Not long since it was the general practice to take the air in through the carburettor by means of an open pipe; this led to excessive engine wear. Many devices have been tried, including water filters—*i.e.* the air being sucked through a volume of water. This, however, was unsatisfactory from many points of view, and has been discarded. Trials have

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been made with an apparatus fitted with felts of various dimensions and sizes; this system failed for the reason that the operator did not change the felts often enough, and the finest particles were drawn through into the engine, naturally causing great damage. One leading manufacturer of to-day still retains the felt cleanser, but of generous proportions, owing to the position of the radiator. It is realized by experience, which has been gained in countries in Europe where conditions of long periods of drought exist, that to make a tractor at all practical and efficient an air clarifier and oil clarifier are indispensable. The present practice is for an apparatus to be fitted that can be removed easily and cleaned, and in which the air passes over or through a series of plates that have been dipped in oil. At the beginning of each day's work the plates—which are in the form of a cartridge and easily removed—are washed out by paraffin; they are again immersed in oil and replaced. This operation takes very little time, but the results in the reduction of wear on cylinders, pistons and other working parts are remarkable, and will give a much longer life to the most important part of the tractor—the engine.

Another important feature is the filtering of the lubricating oil from the sump of the crank-case. The oil passes through a filter, fitted with felt pads or coils. In this way the oil is cleaned of all foreign matter before being again pumped through the main oil channels. The results of this system add longer life to all wearing parts.

*General-Purpose Tractor.*—In laying down a definite specification for the above tractor, consideration must be given to the various conditions and requirements that are met with in the various parts of the world; and it is only by close study and careful analysis of these conditions that I am endeavouring to outline what in my opinion a tractor should embody to serve a useful purpose in the agricultural world. The tractor for general purpose on the average farm, in my view, should be of the light type—22 to 30 horse-power, at revolutions not exceeding twelve hundred per minute; four cylinders; good, strong and efficient radiator; gear drive fan and water pump; governed engine; magneto ignition; forced lubrication; crank-case to be of strong design; easy access to all parts requiring adjusting; ball-bearings to be made as dust-proof as possible; two speeds and reverse; all gears to be machine-cut and of highest-grade material, heat treated; rear axle to be of strong design; ample brakes to be fitted on rear wheels for use when on road haulage; weight not to exceed 30 cwt.; to have belt-power and speed capable of driving full-sized threshing-machine or any other implements used on the farm; adjustable draw-bar; facilities for changing spuds or strakes quickly and replacing with solid twin-tyres on rear wheels, single on front without change of wheel; to

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be fitted with an air clarifier and oil filter; the front axle to be sprung and pivoted, capable of movement to accommodate wheels on irregular surfaces—in general, a tractor that can be operated easily, economically, and be capable of use for all the various requirements of farm work in general.

There is, of course, a field for tractors of a large horse-power and of a heavier type, but a tractor on the above lines will be found quite sufficient for the average requirements of the agriculturist.

*Implements for use with the Tractor.*—There is still much to be desired in the question of co-ordination of interests between the implement manufacturer and the tractor maker. At a very important demonstration under the auspices of the French Ministry of Agriculture, in October 1927, it was observed that where the implements were doing bad work the blame was put on the tractor, and it was at once condemned. Whereas, actually, the tractor was performing its function of drawing the implement, but the implement was totally unsuitable for the work it was called upon to do. Developments of improved ploughs for tractor use are taking place in France and Germany. The advantages are many: ease of control; mounting close to and integral with the tractor; automatic self-lift; one-way operation; and over-all length of tractor and plough reduced to a minimum.

A few figures of the growth of the tractor use in America since the War may be of interest. The figures below are taken from an official statement made to the Pennsylvania College of Agriculturists:

In 1924 there were in use in that state 18,467 farm tractors and 452,000 horses. Assuming 1 h.p. for each horse and 10 h.p. for each tractor, the horse provided 71 per cent. of the draw-bar horse-power, and the tractors only 29 per cent. The figures given for 1924 compared with 1920—for tractors—show an increase of 224 per cent., as in 1920 the numbers stated to be in use were approximately 5697. The official statement also quotes that savings were effected by the use of tractors, the cost in ploughing being 1 dollar 75 cents. per acre. Given a ten-hour working day the tractor will plough approximately five acres, where the work done by a pair-horse team is approximately two acres. Cotton growers state that on a two-hundred-acre plantation the cost of the tractor can be saved in one year as compared with similar work done with a four-horse team.

In conclusion, it is of the highest importance for the future welfare of this country that every help and encouragement should be rendered to the agriculturist to use mechanical power on the farm. The modern tractor can and will do the work required at lower cost, saving of time, and with increase of crop. In the interest of British agriculturists I trust that the responsible authorities

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will give a strong lead to the extended use of the tractor in this country, which will restore the agricultural industry to its right and proper position and so benefit the community at large.

### THE CARE OF THE TRACTOR ON THE FARM

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AN agricultural machine or implement usually suffers from the simple fact that it is an inanimate object—*i.e.* it is without life or soul. Whilst most owners will give some measure of personal attention to even the meanest and least profitable animal on a farm, there are many who, having bought a machine, turn it over to a heavy-handed individual who has no knowledge of its construction, no interest in its success, and little or no inducement to acquire that knowledge or stimulate an interest.

Tractors may be divided, roughly, into two broad classes—firstly, the petrol or paraffin class; and, secondly, the steam class. I propose to confine my remarks to the former.

If an engine starts up at the first swing and runs with a healthy purr, indicating that all is well, a driver feels that he has made a good start for the day. This feeling of satisfaction is amplified if the engine answers to the throttle, and pulls in the field as though it took a real interest in its work. In the case of an engine that has been in use for any length of time these results are not obtained without trouble, but it is surprising how long an engine will keep in good condition if it receives consistent attention, and all adjustments are carried out as soon as they become necessary. Apart from the actual breaking of a vital part the diseases from which an engine suffers can be classified, roughly, under the general name of troubles, as follows: ignition, fuel supply, lubrication, valves, and water circulation. To this list of evils may be added knocking or noisy sounds, which are not evils in themselves but are simply warnings that all is not well.

*Ignition.*—It is of vital necessity to keep the coil or magneto free from damp, because if the condenser becomes damp it will not only cause leakage and failure of the ignition but will not hold any charge, and the resulting spark will not be efficient. Great care should always be taken to avoid spilling water over either coil or magneto, and should any be spilt thereon it should at once be