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Table of Contents

I. MAIN FEATURES OF TECHNOLOGICAL DEVELOPMENT IN TRACTOR MANUFACTURE IN THE NEAR FUTURE

Pages 1-2 Unsigned article

In the decree of the December 1959 Plenum of the Central Committee of the CPSU regarding agriculture it was stated: "A most important feature of the expansion of mechanization in farming in the next few years must be the shift to higher operating speeds for tractors and the principal farm machinery, the development for this purpose of new types of tractors, farm machinery and implements, and supplying collective and state farms with machinery and tools for these processes which have lagged behind in the general over-all machinization of agricultural production (grain cleaning, loading and unloading operations, harvesting cotton, sugar beets, potatoes, over-all mechanization of livestock farms, transportation on the farm, mechanization of operations in fruit culture and viticulture, and others)".

This decree gave a clear cut definition of the main course of development of the Soviet tractor industry in the immediate future. The Plenum of the Central Committee of the CPSU also commissioned the USSR State Planning Board to guarantee the production and delivery of tractors to agriculture in sufficient quantities to make possible spring sowing in 5-6 days and grain harvest in 10-12 days.

There will be a particular increase in the production of wheel tractors which agriculture needs above all else.

However, we must point out that getting the most important farm operations done at the best time depends not only on the delivery of a large number of tractors to the farms but on increasing their production capacity, largely by using more powerful engines for the purpose of increasing the operating speeds of tractor-machinery aggregates. We know, for example, that the production capacity of the T-75 tractor from the Kharkov Tractor Plant with a 75 hp engine is 30-40% greater than that of the DT-54 of the same traction class but with a 54 hp. In the planned standardization of tractors for 1959-1965 it is proposed to increase engine power in all tractors by an average of 40%. Along with the increase in power the weight of the tractor will be reduced through improved design. It is assumed that the weight of wheeled tractors will decline 16-32% in the different classes from 1958 to 1965.

Apparently this tendency will take place in subsequent years to the extent that agriculture is able to master the new speeds in tillage operations. The reduction in weight requires, in addition to design factors, the more extensive use of high-grade lightweight materials such as alloy steels, aluminum alloys, and plastics. For example, the proportion of aluminum will increase in the coming years from 1.1% to 6.4% and that of plastics from 0.02% to 3.0% and more.

In addition to the fact that the tractor must be provided with a sufficiently powerful engine and adapted to working at high speeds, it must also meet the following trends in the development of its structural elements:

1. Improvement in the fuel economy of tractor engines with reduction in the minimal fuel consumption to no more than 175 grams/electric horsepower-hour in high-power diesels and 190 grams/electric horsepower-hour in low-power diesels. In this respect the factories specializing in tractor engine manufacture have a lot of work to do. The more efficient use of the nation's fuel resources requires the development of varieties of tractor engines (for light-type tractors) operating on gasoline.

2. The development of different types of infinitely variable transmissions including hydrostatic for farm tractors, hydrodynamic for industrial tractors and electromechanical and electric for especially powerful industrial tractors and the use of devices for easier and automatic tractor driving.

Tests of experimental tractors has made possible the determination that driving two automatically controlled tractors in echelon with remote control (the tractor driver controls the second tractor by radio) is a feasible method for extensive land areas. This method combines automatic tractor control of the Loginov system with radio control developed by the All-Union Institute of Farm Electrification; to be sure, under automatic control tractor production capacity is somewhat reduced but we may expect that the incorporation of infinitely variable transmission into tractor design will make it possible to overcome this shortcoming.

We must point out that work in developing infinitely variable transmissions and hydraulic transmissions is not now being done in an organized fashion. The work is being done by a number of plants, as for example the Lipetsk, Chelyabinsk and Kharkov tractor plants, the Kharkov Tractor Assembly Plant and such institutes as the Institute of Automobile and Tractor Research, the All-Union Mechanization Institute, and others, each one working separately. They must be coordinated by setting up a coordinating center in the Institute of Automobile and Tractor Research.

In the coming years before the development of perfected infinitely variable transmission use must be made of variable speed transmissions in which gears can be shifted without stopping the tractor. They must have a sufficient number of gears, operating, hauling and reduced, and in certain types of tractors reverse in all gears. The tractor must be equipped with power take-off shafts of various types.

3. Considerable improvement in the adaptability of wheel tractors to difficult terrain. Fundamental measures might include a reduction in tire pressure from 0.4-0.5 kg/sq.cm., improvement in the design of tractor tires and extensive use of four-wheel drive. It is also necessary to develop lightweight reliable designs for dismountable semicrawler drives which would make it possible to start early spring work with wheel tractors at the same time as with crawlers.

For wheel tractors it must be possible to regulate track width and add additional weight to the rear wheels.

4. Providing equipment to improve the working conditions of the tractor driver and to make sure that safety requirements are met. When a tractor is working with a trailer it must be possible to brake the trailer from the driver's seat. The tractor must be equipped with a cab which can be heated in winter and ventilated in hot weather. It must be equipped with signals needed for tractor operations and for moving along the highway. Wheeled tractors must be fitted with hydraulic power steering.

The service life of tractor mechanisms must be increased by 50-100%. In order to make tractor operation and production simpler and less expensive there must be greater standardization of parts and mechanisms by creating standard series.

We must raise the technological level in production and increase accuracy in the production of appropriate parts.

Tractor design must aim at centralized or group lubrication systems.

We must point out that design organizations have now started giving more attention to improving working conditions on tractors. In particular, comfortable cabs for T-75 and DT-75 tractors have been designed at the Kharkov and Stalingrad tractor plants.

Designers and technicians at plants and institutes must greatly lengthen the life of tractor running gear, transmissions and engines. This will reduce expenses for repairs and will reduce the net cost of tractor operations. It is necessary that along with increasing the quality of the basic units of the tractor, related branches of industry (rubber, chemical, electrical, etc.) should also do work in improving the quality and service life of their items. It is particularly important that the quality of diesel fuels and oils be improved.

The decree of the Plenum of the Central Committee of the CPSU aims at the development of machinery for those branches of agriculture which have lagged behind in the general over-all mechanization of agricultrual production.

Up till now we are not producing tractors for orchards, vineyards or cotton processing, for mountain farming, lumbering and certain types of industrial tractors. Designers and technicians at the Lipetsk, Kharkov, Chelyabinsk and other tractor plants are obliged to finish as rapidly as possible designs for new tractors and put them into production in the time indicated.

Of considerable importance in the current shift to improved tractor models is having designs in readiness before absolutely needed. We know that it takes from 3 to 5 years between the drawing board and the start of production of a new tractor. Unfortunately, many of our designers are not now concerned with designing more promising models. As a result, the model which is put into production rapidly becomes obsolete because of the prolonged preparations.

Frequently for lack of time the designing, testing and correction of the model is being done at the same time that production is being set up. As soon as the designer has indicated the coordinates of a housing member the engineer immediately orders special machine tools (and sometimes even automatic lines) for this part. This restricts the designer and deprives him of the opportunity to make necessary changes in the drawings. This was the case with setting up production of the T-30 tractor at the Lipetsk Tractor Plant and air-cooled engines at the Vladimir Tractor Plant.

Where design organizations are working on improving models the new machines are put into production without unnecessary disorder and excessive expenditures.

In this connection we have the positive experience of the Minsk Tractor Plant which always operates ahead of schedule in designing.

The Kharkov Tractor Plant this year will put into production the modernized T-75 tractor and this same year it started testing the tractor-prime mover which is to replace the T-75 in production in 1962. The Lipetsk Tractor Plant, while putting the T-30 into production this year has already developed new designs and is starting to test tractors which will be put into production in the next few years.

According to the decision of the Plenum of the Central Committee of the CPSU the State Committee on Automation and Machinery Manufacture of the Council of Ministers of the USSR in conjunction with the State Planning Board of the USSR has worked out measures for expanding design and experimental bases in the tractor industry.

We must say that during recent years our design organizations have been expanded, large experimental shops have come into operation, and design staffs have been increased. We still need a further expansion of design and experimental bases but this requires of designers that they not lag behind in producing new designs, not require plants to set up production on an item not yet finished off, have designs in reserve ahead of schedule, work from a long-range point of view, incorporate into their designs all that is best in practice throughout the world, and create original and better designs.

During the period 1960-1961 almost all tractor plants must pass on to turning out new tractor models. In place of the DT-54A tractor heretofore turned out in the largest quantity, the Stalingrad Tractor Plant will start production of the DT-75. The Kharkov Plant will be producing the T-75 tractor beginning with the second half of 1960. The Altai Tractor Plant is conducting state tests and is ready to start production on the T-4 (4-ton pulling class) in 1962.

The T-75 and DT-75 are general purpose tractors of the 3-ton pulling class. They will be equipped with 75 hp engines which will make it possible to pull a 3- or 4-bottom plow at a depth of 25 cm with a soil resistance of 0.72 kilograms per sq.centimeter. For heavier soils we have the T-4 tractor with a 90-100 hp engine.

We must say that machinery operators in agriculture are impatiently awaiting the new T-75, DT-75 and T-4 tractors which will make it possible to advance to greater operating speeds in tillage.

The Minsk Tractor Plant has started in 1960 to produce modernized MTZ-5MS and MTZ-5LS tractors with more powerful engines facilitating greater operating speeds. In 1961 the plant is to set up production and start turning out new MTZ-50 and MTZ-60 tractors with 50-55 hp and 60-65 hp engines, respectively.

The MTZ-50 tractor is markedly lighter than the MTZ-5M (design weight 2350 kilograms) and has smaller dimensions. The tractor is outfitted with a drive pulley and an independent and a synchronous power takeoff shaft. The 9-speed transmission and the torque amplifier make it possible to attain moving speeds of from 1 kilometer per hour to 24.3 kilometers per hour. The tractor has hydraulic power steering, a device for shifting additional weight to the drive wheels, and automatic coupling. The production capacity of the MTZ-50 and MTZ-60 tractors will be 15-20% higher than that of tractors now being put out by the Minst Tractor Plant. The Lipetsk Tractor Plant, starting this year, is starting on production of the T-30 wheel-type universal tractor intended for mehcanizing difficult operations in farming, mainly in row crops. The tractor has a wide range of speeds from 1.34 to 20.4 kilometers per hour (reverse for all gears) which makes it possible to use it both in farming and in hauling. The tractor has a 35-40 hp air-cooled 4-cylinder engine. The weight of the tractor is 1900 kilograms.

The Vladimir Tractor Plant specializes in the production of air-cooled engines and in order to fully utilize plant capacity will also turn out T-28M wheel tractors.

The Chelyabinsk and Onega Tractor Plants are shifting to the production of new improved tractor models.

The Kharkov Tractor Assembly Plant has shifted in 1960 to the production of the T-16 improved self-propelled chassis.

The Plenum of the Central Committee of the CPSU has set up great objectives for machinery operators in farming. It is the duty of the tractor manufacturers to assist them in every way.

II. UNIVERSAL MACHINES ARE THE MODERN ANSWER TO THE DEVELOPMENT OF NEW AGRICULTURAL EQUIPMENT

Pages 25-26

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The solution of the problem set up by the Party and government regarding the over-all mechanization of all branches of agriculture is connected with developing and adopting hundreds of various modern farm machines, implements and attachments during the seven-year plan.

The development and production of such a large number of items is a most complicated affair, requiring the expenditure of considerable state resources and the labor of many specialists in farm machinery manufacture. In the meantime there are still neglected possibilities for sharply reducing these expenditures by replacing the large number of special machines by a smaller number of universal machines which will fulfill the functions of the former.

In order to combine the functions of several different machines into one we must have the existence of specific conditions, among which the principal are a relationship between technical processes being done by these machines (which makes it possible to carry them out with working units similar in design and arrangement) and the absence of a seasonal overlap in the farming operations which are to be combined in one universal machine (otherwise the machine cannot be used for different operations if they coincide in time). No less an important condition for combining several into one universal machine is the assurance of high operational reliability. To illustrate the advantages of replacing simple machines by universal ones we may cite the example of certain indicative features of a universal corn and silage combine.

This machine combines the functions of a silage harvester and a corn-picker. The technological processes of these machines include certain common operations such as cutting stalks of plants, breaking them up, conveying the chopped mass inside the machine and loading it into vehicles for hauling. The only distinguishing operation in the second machine is the separation of ears of corn from the stalks and loading them, which is done by additional working units. The ensilage and corn-picking season are separated, following one after the other at an interval sufficient for preventive machine maintenance.

The weight of the universal machine developed is 3500 kilograms while both machines which it replaces have a total weight of approximately 5400 kilograms. The approximate cost of the universal machine is 20,000 rubles while the cost of the two replaced machines is 37,000 rubles.

In order to imagine the efficiency of such a replacement in a country of our size, we should state that by the end of the seven-year plan it will take 75,000 corn harvesters and 56,500 silage harvesters to harvest all the corn sown in the southern areas. These machines can be replaced by 56,500 universal corn-and-silage combines. This will effect a savings of more than 154,000 tons of metal and approximately 883,000,000 rubles.

A reduction in the types of farm machinery by the shift to universal machines will simplify their operation, storage and maintenance and, in addition, will effect a savings in spare parts. Lengthening the time of use within the year reduces the obsolescence factor since the machine wear will take place at a more rapid rate making it possible to replace the machines by modern improved machinery. It is difficult to construct special sheds to house a large number of machines. With the combination of approximately two special machines into one universal one the diversity of machines would be reduced by half. And in some cases it will be possible to combine more than 2 special machines into one. There are quite a few such examples: in the PG-0.5 grab loader, one universal grab replaced three different types of grabs, providing a loader for many types of loads.

The TU-5 universal conveyor is used for loading and unloading various types of farm products. The SZPB-2.0 grain drier developed on the universal principle can dry the seeds of eight different crops as well as drying green grass for high-vitamin hay and clover. The OKhM-500 combination carries out three functions: cleans, chills and, in case of necessity, separates milk, thus replacing three separate machines. Considerable work has been done on the development of universal machines incorporating drills, cultivators, etc.

Design ideas are also following a somewhat different line with regard to universal machines. As an example we may take universal self-propelled chassis which can be combined with entire sets of mounted implements. The chassis combine such common machinery units as engine, running gear, hydraulic equipment, distributing box, etc. The absence in each of these mounted implements of these complex and costly units reduces their weight and cost. The weight and cost of the chassis is spread out over all the mounted machiner. This makes it possible to incorporate into the chassis automation elements and other mechanisms which make labor easier and increase the production of combinations which it would not be profitable to incorporate into each of these machines. Here we might mention the already developed SSh-65 and SSh-45 self-propelled chassis and the ShUP semiself-propelled chassis for the "Belarus" tractor with sets of implements.

Both these trends in providing universal machines are not only not contradictory but complement each other since the universal machine may at the same time be mounted on a universal chassis. Such examples are already in practice.

The development of universal farm machinery is very advantageous to the national economy and to collective farms in particular.

Unfortunately this problem is not being given enough attention and the activity of research and design organizations in farm machinery manufacture is not aimed at a solution. Sometimes insignificant shortcomings in universal machines as shown in qualitative or other indications are, by comparison with simple machines, a stumbling block to their adoption. However, if these shortcomings are compared with the advantages of universal machines, it will be clear that even with their shortcomings the universal machines are much more profitable than the simple special machines. In the beginning there may be certain shortcomings in universal machines but there is no doubt that they can be eliminated technologically. In our opinion, the development of universal machines must be one of the most important trends in agricultural machinery production. It will make it possible to reduce greatly the number of types of machines which must be made to mechanize the multiple farm production operations which are based on various technological processes. This will make the use and operation of farm machinery easier, cheaper and more widespread.

The December 1959 Plenum of the Central Committee of the CPSU gave no small amount of time to the mechanization of agriculture and to agriculture machinery manufacture, the effective development of which is related to the more extensive use of new progressive trends such as that toward universal machines.

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