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LET US INCREASE THE MOBILITY OF ROAD-BUILDING EQUIPMENT

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Red Army offensives during World War II set the road squads the task of ensuring free and uninterrupted troop movements. The speed with which advances develop demands maximum efficiency by military road-building squads, which is determined by their speed of deployment and promptness in starting work. Rapid movement and use of mechanical appliances is therefore necessary.

Deployment of road-building squads under front-line conditions involves moving heavy road equipment, such as tractors, rollers, graders, scrapers, stonecrushers, concrete mixers, pile drivers, compressors and other machines, for great distances. Road-building machines as a rule move under their own power or are drawn by motor transport.

However, experience has shown that movement of graders, scrapers, stonecrushers, and concrete mixers on metal-rim wheels and other unsprung machines with trailers, for a distance of 100 kilometers, even at the slow speed of 10 kilometers per hour, often results in putting them out of commission. Movement of tractors, excavators, rollers and other road-building equipment under their own power for considerable distances (over 50 kilometers) leads to rapid wear of undercarriages, considerable damage to and even failure of machine fastenings. Moreover, the speed of tractors transporting machines is too slow.

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To increase productivity and maneuverability of road-building squads and to have the equipment always in technical readiness, road-building machines should, as a rule, be moved with the personnel and material of the squad at normal automobile speed (average 30-40 kilometers per hour).

Mobility of road-building equipment is no less important in peacetime, especially in assembly-line methods of road building, where all machines are continually being moved. Mobility of road-building machines considerably increases their utilization coefficients, and auto propulsion helps safeguard their structure during transport and loading and unloading on railroad lines.

During the Patriotic War military road squads on all fronts moved their machines by auto transport and on trailers towed by powerful trucks, using various simple appliances.

The object of this article is to sum up the experience gained in the Patriotic War in transporting heavy road-building equipment, to indicate the most efficient of the existing auto propulsion arrangements, and to note the requirements in this field.

A. Transportation Arrangements on Road Machines

Most mobile road machines have heavy metal wheels and plain bearings, completely unadapted for towing by auto transport. It was not until just before the war that individual machines (trenching plows, trailer rollers, graders, etc.) began to be fitted with ball and roller bearings and pneumatic tires (Figure 1).

Abroad, especially in America, trailer road-building machines have long been fitted with roller bearings, rubber tires and in some cases spring axles. Trenching plows, graders, autograders, scrapers, (Figure 2) tractor trailers, road harrows and cutters, stone crushers, concrete mixers, and many other machines run on rubber. Low pressure tires are usually used on heavy machines; they have greater surface area and lower pressure. Very heavy machines (excavators, concrete mixers, pile drivers, cranes) have caterpillar tracks as a rule. Standard automobile high pressure tubeless tire is used for ordinary road-building machines up to 10 tons. Solid rubber tires have recently gone out of use because of their uneconomical features, high wear of rubber and poor cushioning.

The methods used for transporting motor rollers vary considerably. Medium rollers (6-8 tons) made by German and sometimes by American firms have four special removable wheels with rubber tires or with flanges for railroad tracks (Figure 4). Reduction gear ratio is high. Hence speeds are 10 kilometers per hour on rubber tires and 15 kilometers per hour on railroad tracks. The transport wheels of these rollers are usually fixed on crankshaft divided axles which are lowered into the bottom position and locked with special stops while the roller is jacked up.

The Buffalo single-roller 5½-ton motor roller, which has swivelling front wheels with pneumatic tires, has a novel arrangement for rapid transportation as a two-axle trailer. The towing link is attached to the front of the chassis. The roller, engine and transmission in the casing are raised (by means of a manual hydraulic jack) about a pivot fitted at the rear and connecting the casing with the chassis.

The Buffalo single-motor 7-ton motor roller, which has a supporting steering wheel in front on tires (Figure 6) is equipped with collapsible pneumatic rear wheels. When the driving wheels are set up, gears mounted on their hubs engage with the roller transmission.

The Littleford 2-ton single-roller motor roller, which has a small supporting metal roller (Figure 7) has two pneumatic transport wheels mounted on a cranked axle attached to a hand lever so that in its working position the transport wheels are raised. When it is moved through 180 degrees they are lowered, raising the rolling and supporting rollers. The machine is towed by a truck.

B. Transport of Road Machines by Trucks

Trucks provide the most convenient method of transporting tractors and prime movers for road machines. STZ - NATI tractors are easily transported by ZIS-5 trucks with the boards removed. To avoid broken springs on a bad road it is recommended that pieces of old tire treads be placed under the springs as cushioning; in extreme cases arresters should be used. ChTZ heavy tractors are transported on 10-ton trophy (trofeyniy) and "Mak" /Mack?/ trucks. Experience has shown that it is permissible to overload medium and heavy trucks (3 tons and over) by 20 - 30 percent, the speed being reduced to 25 kilometers per hour.

The Ya G 5-ton truck was frequently modified for transporting ChTZ tractors when there were no heavy trucks available. The frame was lengthened by 1,600 millimeters and a supplementary axle with four ramps suspended from the Ya G. In order to ensure a sound joint, straps and crossties, carefully worked, were inserted within the longerons at the butts. This modification increased capacity of the Ya G truck to 10 tons.

Tractors, rollers and other heavy road equipment were loaded under field conditions by means of a ramp(?) which could always be dug, adapted to the relief of the site. The machines were handled by means of a hand winch or a pusher tractor. Machines without wheels on tracks were loaded using rollers, iron sheets or other methods.

C. Special Appliances for Transporting Machines by Auto Transport

Large and cumbersome machines were towed by trucks. In particular, 10-ton motor rollers and heavy graders were transported in front-line conditions by ZIS -5 and Studebaker trucks by means of a special single axle Ya G trailer on four ramps which took an 8-ton load (Figure 8). A more complicated system was to couple a grader and motor roller to a trailer by means of special bridging boards and securing bolts, which were designed for each particular make of machine. The latter constituted the main drawback of the scheme.

The American firm "Buffalo" provides for the transport of their medium roller as a trailer to a truck (Figure 9), two wheels with tires being fitted for this purpose. The roller rests on the truck platform by means of a special clamp. Many heavy road-building machines are carried on light trailers provided by the manufacturers. For example, all semi-stationary asphalt mixers have trolleys of this type. Figure 10 shows a "Northwest" (Nordvest) with a special dismountable trolley-trailer. The excavator mounts the trolley under its own power using wooden blocks, the front part being removed; it is then driven on, the trolley jacked up and the blocks removed.

The former Narkomsnab (People's Commissariat for Machine Construction) produced three types of trailers at various times: 6 ton -- of little use owing to its small capacity; 12 ton -- for motor rollers only and useless for tractor transport, with numerous design faults; 40 ton -- unfit for use because of undercarriage defects and lack of arrangements for loading and unloading heavy weights.

During World War II the Road Administration of the Red Army organized a contest for a transport device for carrying various road machines and tractors in conjunction with Studebaker trucks.

It was proposed to utilize the existing prime mover gearbox for loading and unloading the machines.

Figure 11 shows the road trailer semitrailer invented by Engr-Maj A A. Vasil'yev and Engr A. Z. Rusanov, which won second prize.

The trailer consists of a saddle-type semitrailer pivoted to the chassis longerons through a special rotating mechanism so that the vertical support axis coincides with a line passing through the center of suspension of the rear axles. The double knuckle joint of the rotating mechanism ensures longitudinal and transverse alignment of truck and trail platforms. The saddle type semitrailer construction has the following advantages:

1. It reduces the weight of the trailer, since there is no front axle.

2. It increases the forward load of the truck enabling its maximum tractive force to be utilized.

3. It increases maneuverability and stability in traffic as compared with a trailer with a tow bar (total length is reduced and turning is accomplished through one pivot only.)

4. The coupling is more reliable. This is especially important on inclines.

5. Cost of manufacture is reduced by a saving of metal, wheels, springs, etc.

The Studebaker "US x 4" chassis (rear-wheel drive), with self-actuated winch for loading and unloading heavy weights, was chosen to draw the trailer. The trolley at the back end of the trailer consists of the axles of two independent balancers and four wheels on Ya G pneumatic tires (40 x 8) maximum wheel load being 2,500 kilograms. They are located one behind the other, two on each side. This enables the trailer to follow steadily along an uneven road.

The trolley has hydraulic brakes operated from the trailer system. The trailer has a useful capacity of 12 tons and is suitable for general use as it can accommodate ChTZ tractors, motor rollers and other heavy road-building machines. A special extensible trestle arrangement is provided for carrying trailer graders. The grader is lifted on to it by means of the winch and loading gangway. This arrangement is necessary because the overall dimensions of the grader exceed those of the trailer platform, and increasing the size of the latter is not feasible. The gangway is dismountable. Weight unloaded is 3 tons, load on rear trolley 8.5 tons, front 6.5 tons. Average speed when loaded is 30 kilometers per hour, when unloaded, 40 kilometers per hour. Turning radius is 20 meters. Lifting force of winch purchase is 4.5 tons.

D. Mounting Road-Building Equipment on Trucks

During the war military road units manufactured and mounted the following equipment on trucks: planers, cranes, pile drivers, asphalt spreaders, snowplows, repair shops, dumpers, timber transporters, compressors and electric generators.

Auto transport made considerable use of self-contained repair shops for

erection purposes. A special bridge-building train was provided for military bridge units by the Chief Road Administration of the Red Army. It had 15 trucks with trailers, containing all equipment needed for building and repairing bridges; pile drivers, winches, wood saws, power saws, electric and pneumatic tools, electrostations, compressors, welding machines, blacksmith equipment, etc.

Judging from World War II experience and foreign practice the following measures are needed to increase the mobility of road-building machines.

1. Reduce weight of machines as much as possible

2. Equip machines with means of transportation at 30-40 kilometers per hour

3. Extensive use of trucks to carry excavators, cranes, planes, asphalt spreaders, bitumen heaters, snowplows, repair shops, brushes, sprayers, cleaning machines, dump trucks, timber transporters, concrete carriers, compressors, electric power plants, workshops, etc.

4. Provide special trolleys for transporting collapsible semi-stationary structures, asphalt-concrete mixers, cement-concrete plants, etc.

5. Increase transportation speed of self-propelled machines to 20 kilometers per hour, including autograders, stackers (ukladchiki), etc.

6. Fit transport wheels to motor rollers, 3 ton pavement and light and 6-8 ton medium. The former to be towed by trucks, the latter to proceed under their own power at 15-20 kilometers per hour.

7. Manufacture 12-ton trailer-semitrailers of the saddle type for heavy rollers (10-12 tons), tractors, and nonmobile road equipment.

8. Provide for the manufacture of 40-ton trailers for light and medium excavators.

9. Fit low-pressure balloons on 8-10 ton machines working under severe ground conditions; the wheels of machines should have automobile pneumatic tires.

10. Equip axles of machines with ball or roller bearings.

11. Trolleys and machine axles must be sprung for smooth running at high speeds.

12. Fit buffer and amortization springs to tow bars for smooth starting and braking.

13. Fit trolleys with brakes.

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