Improving the layout of skid steer loader

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Abstract. The article analyzes the layout of the main components and units of a skid steer loader. The effect of placing the heaviest components on the tipping load is estimated. The necessity of increasing the duration of the loader without refueling is substantiated. An option is proposed to improve the layout of the machine to increase its operational performance. A test arrangement made using a 3D-modeling system is given.

1. Introduction
Skid steer loaders are designed specifically for operation on sites of limited area requiring considerable maneuverability [1]. The on-board steering scheme in combination with a hydrostatic transmission is well suited to meet this operational requirement. When making an on-board turn, it is necessary to overcome a greater friction force, compared with loaders with steered wheels, which leads to greater fuel consumption.

In the most common class of loaders with a loading capacity of 800 kg, the volume of the fuel tank is 40 - 50 liters. This is enough to work with an average load for 8 hours. However, there are situations when it is required to carry out work of 10 or more hours per shift, and also take into account the fuel consumed when moving between the objects on which the loader is operated. Therefore, the issue of increasing the operating time of the machine without refueling is relevant.

2. Purpose and objectives of design
The purpose of improving the layout of the skid steer loader is to select the optimal placement option for the main components and assemblies, as well as the rational selection of components included in the machine system. In this regard, the design solves the following problems: layout of the fuel system, selection of transmission components, layout of the hydraulic system of the loader.

3. Skid steer loader layout
The layout of the skid steer loader is determined by its functional purpose. The basis of the design is a spar-type box frame. The hinges of the boom are fixed at the rear, the working equipment is at the front (Fig. 1). The components with the largest mass (engine, fuel and hydraulic tanks) are located at the rear of the machine to provide the necessary tipping load [3].
4. Fuel system layout
One option to increase the loader's operating time without refueling is to increase the amount of fuel placed on the machine. Typically, the loader is equipped with one fuel tank located along one of the sides at the rear of the machine. On the opposite side is a hydraulic oil tank. If the hydraulic tank is placed in another part of the machine (for example, under the cab), it becomes possible to install another fuel tank instead. In this case, the fuel is stored in two tanks with a total capacity of about 90 liters.

Two fuel tanks 2 and 3, located in the rear of the loader symmetrically with respect to the longitudinal axis of the machine, are interconnected by a fuel line 5 through a tee 6 (Fig. 2). The tee nipple is connected via a fuel hose 7 to the fuel system engine 1. Each of the tanks is equipped with a filler neck with a breather 4 for refueling and maintaining in the tank a pressure close to atmospheric.

Fuel consumption occurs simultaneously from both tanks, due to which the mass distribution remains uniform and stability is maintained during operation of the loader.
5. Choice of transmission scheme and components

Skid steer loaders are equipped with a hydrostatic transmission [2], which consists of two hydraulic pumps and two hydraulic motors. On modern loaders, axial-piston hydraulic pumps mounted on one drive shaft in the form of a tandem are most often used. This design option allows you to reduce the number of links for transmitting torque from the engine to the transmission [3].

The transmission diagram of the skid steer loader is shown in Figure 3. Engine 1 is connected to the tandem of the pumps through a friction clutch. The tandem of pumps includes two axial-piston hydraulic variable pumps 2 and charge pumps 3, built into each of them. Hydraulic motors 4 are radial piston type with a brake and a drive sprocket. The torque from the motors is transmitted to the onboard chain gears 5, the driven sprockets of which are mounted on the wheel hubs 6.

When selecting a hydraulic filter, a more rational option is to use a transmission filter 7 [4], since it can be placed in a hydraulic tank 8. A suction hydraulic line can be connected to the charge pumps and the drain hydraulic line from the pump tandem via a radiator 9 to this type of filter.

![Figure 3. Schematic diagram of skid steer loader transmission.](image)

6. Hydraulic system layout

The test layout of the hydraulic system of the skid steer loader is shown in Figure 4.

The engine 1, connected to the tandem of hydraulic pumps 2 through a friction clutch 3, form a power unit. Hydraulic motors 4 connected to the pumps by high pressure hoses 5 form a hydrostatic transmission circuit. A hydraulic tank 6 with a filter 7 and a filler neck 8 is located under the floor of the loader's cab. The filter cartridge is replaced and the tank is refilled when the cab is raised.

The drain ports of the tandem hydraulic pumps are combined and connected to the oil cooler 9. After cooling, the hydraulic oil is fed through the drain hydraulic line through the filter to the tank. A suction hydraulic line is also connected to the filter housing, which is connected to the feed pumps of the tandem of hydraulic pumps.

The proposed layout of the hydraulic system has the following advantages: a hydraulic tank, located under the cab at the level of the axles of the loader wheels, can reduce the height of the center of gravity of the machine and improve stability when working with loads and attachments; the reduction of hydraulic routes from the tank to the hydraulic equipment allows to speed up the process of warming up the hydrostatic transmission after starting the loader engine.
7. Conclusions
The operational parameters of the skid steer loader depend not only on the characteristics and design of its components and systems, but also on their rational layout. The article presents the results of the verification layout of the loader. An option was proposed for the placement of components of the fuel and hydraulic systems, which allows to improve the operational performance of this class of equipment.

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