

HYDRAULIC SYSTEMS FOR DRIVE AND CONTROL OF AIRPORT MACHINERY

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This article concerns the hydraulic control system and operation of airport equipment. Described below is a hydraulic system, the use of funds for airport ground handling, and the most significant airport sweeper. It also contains a description of the hydraulic system, analysis of its advantages, disadvantages and possibilities of improvement.

K e y w o r d s: hydraulic system, hydraulic control system

1 INTRODUCTION

Hydraulic drive systems are important application for the major part of modern machinery and equipment at the airport. Their use allows developing of new concepts for equipment with sufficient operational parameters, with higher efficiency, less weight, greater regulation range and higher reliability of operation. Summary of the use of the hydraulic system is to facilitate airport operations and reducing delay, for example. the clearance of the aircraft, resulting in an increase in airport's prosperity. The continuous development of hydraulic systems and equipment for expansion enables trouble-free operation at the airport.

2 HYDRAULIC MACHINES

Hydraulic machinery is machines and tools that use hydraulic drive for the performance of each activity. For these machines there are liquids - so called hydraulic fluids that transmit power throughout the machine to various hydraulic motors and hydraulic cylinders. A fundamental feature of hydraulic systems is the ability to easily used force or torque, regardless of the distance between input and output, without mechanical gears or levers, either by changing the effective area of two interconnected cylinders or effective displacement (flow - liquid volume / speed) between the pump and motor. Hydraulic fluid is controlled directly or automatically by control valves and distributed through high pressure hoses and pipes.

2.1 Use hydraulic in operation at the airport

At the airport we meet with many hydraulic devices that are necessary for passengers boarding an aircraft, airport maintenance, loading cargo aircraft, when embarking disabled passengers. These devices are involved in the daily smooth operation of airports. Many devices are equipped with hydraulic systems. The most important building amenities include tractor, sweeper and forklift.[1]

3 THE AIRPORT SWEEPERS

Sweepers are among the fundamental vehicles of airport vehicles intended for maintenance of paved airfields. In the summer, they are used to remove impurities from the LPP. Impurities or contaminants could be deposited by aircraft machinery, or brought by wind. Using airport sweeper, we are able to eliminate these unwanted elements and ensure fluidity of air transport.

Košice airport is equipped with sweepers made by Overaasen, type RS 200, which are used during winter maintenance of airport operational areas together with other mechanisms.

Sweepers from Overaasen helped to strengthen airport's name and its position in the world. The device is developed in close cooperation with professional users who set strict requirements for capacity, speed and final results.

Sweepers form the most important group of products in the Overaasen's current production program and will undoubtedly continue to be a priority for the future in the production. Conscientious commitment to the development was to be able to adjust the 3,500 m long runway for 10 minutes. Mechanical blower with brushes and a powerful air stream also reduce the need for expensive, environmentally harmful chemicals.



RS series is the most advanced high-capacity, high-speed runway sweeper on the market today. Family of modular RS has a large diameter brush and elegant design.

Computer-aided control system ensures smooth and easy to maneuver coordinated with snow plow, brush by hydraulic cylinders. Relocating device requires

inductive switches or sensors that can corrode or be damaged when exposed to chemical snow, ice and water.

Unlike most other skid steer snow, Overaasen uses a system that allows the device to be able to disconnect and replace it with other Overaasen units, which represents a significant advantage in keeping pace with changing conditions. This modular concept offers operators great flexibility with elements. Diameter of the brush was increased to 1.2 m, resulting in higher performance and better horizontal throw of the snow or dirt. The control system provides a new world of comfort for the operator, while optimizing efficiency.

To minimize wear on brushes, rotary speed can be automatically adjusted to the diameter of the brush and the operating speed of the vehicle. RS series are using numbers of maneuvers, which are based on using of the hydraulic cylinders.

Unique method of finite elements used in design ensures that the machine has no problem even at very high operating speeds.

4.1 The engine

Sweeper is driven by diesel engine with an output of 180 kW to 350 kW. Most European airport sweepers used Mercedes Benz engine type OM 501 LA with the performance of 250 to 315 kW. American manufacturers use engines of 280 to 360 kW (Caterpillar C9-C15). Motor LA uses Electrical preheating with external source of electricity 220 V. Motor control is remotely controlled, the control and monitoring unit is located directly on aggregate.[2]



4.2 Hydraulic pump

The pump is an electric rotary machine or device which increases the pressure or kinetic energy of hydraulic liquid by its static or dynamic transfer. This device converts mechanical energy supplied from an external source (the drive) for transporting liquids. Pumping process (mass transfer) is characterized by a certain amount of liquid transported from tank A to destination B. Hydraulic pumps are divided to hydrostatic and hydrodynamic. The hydraulic system consists of multi-stage piston pumps with an output of 10 to 25 MPa. The system is mainly composed of two independent hydraulic circuits. Through various distributions it drives

and controls the broom sweeper, blower (centrifugal blower) and controls sweeper.

Advantages of piston pumps are self - venting capability, insensitivity to variations in pressure and the possibility of using refueling with fluids with higher viscosity. Piston pumps are used mainly for smaller flow rates, but can handle high pressures.

Disadvantages of piston pumps are significantly greater dimensions than the dimensions of equally efficient centrifugal pumps and larger acquisition and maintenance costs.

4.3 Sweeping brush

Sweeping brush is of a cassette type, it consists of steel or plastic bristles. Startup and lift of the brush is controlled by computer and ensures maximum comfort and efficiency when operating at the airport.

The advantage of the system is an automatic sweeping brush lowering to the required working position during startup and consecutive lifting of the sweeping brush after stopping of the machine. Computer system will automatically increase the rotating speed of the brush proportionally to increased movement speed. Drive is provided using a hydraulic actuator. The hydraulic system is used to tilt the brush into working position while ensuring sufficient down force required cleaning the surface sufficiently.[3]

4.4 Blower

Features:

- cleaning airfields by air stream using compressed air
- possibility to use during summer and during winter maintenance of the airport surfaces
- used either together with a sweeping brush or separately
- compressor is used mostly radial, centrifugal with varying torque
- adjustable power, speed of air from the outlet
- air outflow velocity 80-150 m/s.

4.4 Control

Control, lifting and tilting of snow plow is done by front PTO, which can be controlled electro-hydraulically from the driver's cabin with individual control levers and buttons. Control of individual circuits is done using the buttons located in the cabin, which ensures agility. Control panel contains information on setting of individual elements, operating fluids state, fuel level and more. At the same time track inspection and evaluation indicators can be tracked on the display. Arrangement of the sweeper's controls is designed to be mastered by one person without the need of additional personnel.

4.5 Development of futuristic runway sweeper in Overaasen

The most modern airport sweepers have sufficient optimum performance, efficiency and achieve optimal results in removing impurities from the runways. The new standard for future snow removal is important in the effectiveness of winter maintenance. As well as the provision of new design, where engineers use leading edge, high-tech fiber, glass, composite materials, which provide advanced and innovative concepts, components and aerodynamic surfaces. Quality bristle brush placed in a fully automatic adjustment brush in combination with a new design provides excellent durability of Overaasen sweepers.



Operation is done via its own monitoring system with on-board diagnostics. Sweeper maintenance is now easier and more efficient. Easy access for maintenance is ensured by single piece, articulated engine closures, by which we can rotate backwards exposure all over the engine. Easy maneuverability and extreme agility are the main features of these sweepers.[4]

5. HYDRAULIC SYSTEMS AND OTHER FACILITIES AT THE AIRPORT

Hydraulic systems also have application in other airport resources. This includes devices that contain hydraulic actuator:

- boarding stairs
- cargo loading belt
- scissor cargo loader
- telescopic boom lifts, hydraulic aircraft jacks



5.1 Analysis of improving the hydraulic drive

The main advantage of hydraulic power units is their versatility to drive various devices, variable regulation of required power, and ease of install using quick connect couplings and especially lack of mechanical gears and couplings needed to drive the hydraulic equipment.

The main disadvantage of these systems is the higher initial cost, because the power unit is part of the machine. Despite the higher initial cost, the efficiency is compensated by lower operating costs. Additional problems may include leaks caused by poor installation, poor maintenance or bad quality or capacity of the pipe. Disadvantage can be the complexity of hydraulic systems, and thus the demand for more highly trained personnel.

Development of new technology concepts can be expected primarily on the development of components enabling:

- concentration of functions and activities
- transition from direct pressure ties to the controlled pressure ties in the dependent modes of operation
- step up their performance and increase time fund.

ADVANTAGES OF HYDRAULIC:

- high load capacity
- high power density
- exact positioning
- start from zero even at the lowest load
- uniform independent movement
- quiet operation
- good maneuverability
- drive various devices
- using hydraulics can handle multiple lines at once
- low operating costs
- easy one- trained workers
- simple regular maintenance
- the possibility of application to non-traditional work environments
- widespread use
- long life

DISADVANTAGES OF HYDRAULIC:

- oil pollution of the environment
- danger of fire accident
- danger high pressures
- initial price

OPPORTUNITIES:

- expansion into new markets
- greater involvement of science and research in the development of hydraulic
- involvement of domestic scientific experts including universities
- development of components
- global production and expansion devices

- international success
- develop research in the field of hydraulics in collaboration with global experts

THREATS:

- competitiveness
- relocation of production to countries with cheap labor
- lack of skilled workers
- volatility of the currency market

When comparing the advantages and disadvantages we conclude that the purchase of the hydraulic system in the long term and economically worth of benefit. Hydraulics is represented at the aerodrome operating facilities, including airport sweeper, tractor, forklift, mechanisms for de-icing aircraft, scissor lift loader, crawler loader Storage, hydraulic boarding stairs, hydraulic lift, hydraulic jack to move the helicopter, aircraft jacks under during repairs, hydraulic opening hangars and constantly there is a place for the implementation of new equipment, which are at the planning stage. Hydraulics is an area of constant development and evolution of components, which then allows you to install hydraulic equipment in new facilities at the airport, but also in other areas of human life.

Possibilities of improving the hydraulic system for airport facilities derive from several factors, including:

- improve management and control components and systems
- regular inspection of equipment
- increasing the professional competence of the
- use of new components in the hydraulic system
- durable materials hydraulic circuit
- Increased tightness circuit, flexibility, load capacity, equipment
- construction resistant to dirt and dust
- high-tech technology
- cooperation for development with foreign experts

6 CONCLUSION

Hydraulics surrounds us all around in everyday life. The main task is to facilitate the work of man, therefore, the issue of hydraulic circuit is still being discussed around the world.

Improving hydraulics is the top priority at airport hydraulic equipment, which is addressed in the form of scientific research discussions. Many experts are trying to reach through scientific research to improve the hydraulic circuits, which are able to minimize losses and maximize performance. The acquired knowledge is then applied in the manufacture of hydraulic systems. Optimal solutions using hydraulic actuator can be used more efficiently, thus helping to improve the quality of the tasks and the safety of air transportation at airports.

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