TRAM WHEEL FLANGE LUBRICATION

OK - 01

APPLICATION

The OK - 01 lubrication system is designed for lubricating wheel flanges of trams that are not equipped with pressure air distribution. The system works on the principle of applying lubricant mixture to the contact area of tram wheel flanges with rails by means of pressure air. The mixture of lubricant with air is formed in a mixing device behind the lubrication pump, and it is further conveyed through a divider and spray nozzles without other mechanical parts that can be the source of faults. The lubrication system is provided with a function of cleaning the circuit by blowing through when the vehicle is put out of operation for a long time.

Wheel flange lubrication advantages:
- reducing the cost of changing the wheels due to wheel flange wear
- reducing the wear and deformations of rails
- energy saving by reducing the friction between wheel flanges and rails
- reducing the risk of vehicle derailing
- reducing the noise from passing vehicles, particularly at switches and on bends
- shortening the time of putting the vehicle out of operation

The wheel flange lubrication system is installed at the front axle of the tram. When using trams with bi-directional operation, the vehicle must be fit with two systems.

DESCRIPTION

The wheel flange lubrication system (Fig. no. 1: Wheel flange lubrication block diagram) consists of a wheel flange lubrication box (1), mixture divider (2), bracket with applying spray nozzles (3), and electronic control system (4).

The wheel flange lubrication box is installed from the outer side of the vehicle near the front axle. Inside (Fig. no. 3: Internal arrangement of wheel flange lubrication), it is fitted with an air compression unit (item 1 to 7), a lubricant dosing device (item 8 to 11, 18,19,21,22,23), and a mixing device for mixture forming (item 12, 13).

The mixture divider (Fig. no. 1: Wheel flange lubrication block diagram – item 2) and two brackets with spray nozzles (3) are located at the vehicle bogie. The mixture is taken to the divider (2) by a DN8 tube from the mixing device (Fig. no. 3: Internal arrangement of wheel flange lubrication - item13). Each spray nozzle (3) is connected to the divider (2) by a DN4 tube.

The lubrication cycle (Fig. no. 2: Wheel flange lubrication arrangement diagram) is controlled by an electronic control timer (14) located in the cab in an accessible postion. The control timer (14) contains buttons for selecting operation modes I to IV, switches for setting the required times of individual modes, and function pilot lights. Mode IV can be started by a service button (20) connected in parallel, located in the wheel flange lubrication box. Input and output signals are taken through a pair of connectors to the electronic system of the control timer (14).
Input and output signals description (Fig no. 8: Circuit diagram of wheel flange lubrication):

**Input signals:**
- I.1 – service button that is connected in parallel to the mode IV button
- I.2 – pressure switch (12) in mode I signals whether the lubricant and air mixture pressure is sufficient
- I.5 – digital pressure switch (5), starts the compressor (1)
- I.7 – lubrication blocking signal – “Slip”
- I.8 – signal – “Travel”
- I.9 – float gauge (8), checks the lower level of lubricant in the reservoir of the pneumatic lubrication pump (10)

**Output signals:**
- 0.2 – operating valve control (9)
- 0.5 – pressure-release valve control (7) – releasing the pressure from the compressor’s discharge line
- 0.8 – “Lack of lubricant”
- 0.9 – “Lubrication O.K.”

**FUNCTIONS**

Fig. no. 2: Wheel flange lubrication arrangement diagram

**AIR COMPRESSION UNIT**

The function of the air compression unit is controlled by a pressure switch (5). When air pressure in the tank (6) decreases to 3.5 bars, the control timer (14) switches on the connection to the pressure-release valve (7) that closes the connection to the switch relay (15) that starts the compressor (1). During compressor (1) operation, pressure in the tank (6) grows, and when pressure reaches 5 bars (signal from the pressure switch 5), the control timer (14) switches off the connection to the relay (15) of the compressor (1) and the pressure-release valve (7). The compressor (1) stops and the pressure-release valve (7) connects the space between the compressor (1) and the non-return valve (4) with the surrounding atmosphere. In this way, pressure is released from the discharge line, which is necessary for starting the compressor (1) again. The pressure switch (5) signal that stops the compressor (1) tells the control timer (14) that the tank (6) is ready for lubrication. During lubrication, pressure in the air tank (6) decreases and the pressure switch (5) starts the compressor (1) and closes the pressure-release valve (7) through the control timer (4) and relay (15).

**CONTROL SYSTEM**

The lubrication cycle is controlled by an electronic control timer (14) (Fig. no. 7: Control system). The operation modes I to IV are selected on the control timer (14) by buttons and their required times are set by corresponding switches. Mode V is additional to mode III, or separate, and it is used for accelerating the blowing through the circuit using an external source of pressure air with pressure from min. 3 bars to 6 bars.

**OPERATION MODES**

Fig. no. 2: Wheel flange lubrication arrangement diagram

**Mode I – Lubrication**

The time-switched lubrication cycle consists of two stages, stage 1 - lubrication (mixture spraying) and stage 2 pause. The times of stages can be adjusted, for achieving optimal wheel flange lubrication in 15 steps. Pressure air tank (6) filling is independent of travel.
Stage 1 – lubrication (mixture spraying)

Lubrication time can be set by a switch within the range of 1 ÷ 15 sec. During the pause period between lubrications, the control timer unit (14) receives a signal that the pressure air tank (6) is ready for lubrication. When the pause ends, the control timer (14) issues a command for lubrication, sends a stream to open the operating valve (9) through which air passes to the pneumatic piston of the lubrication pump (10) and to the mixing device (13). The lubrication pump (10) forces a dose of lubricant (pressure increase at the pressure switch (12)) into the mixing device (13) and the air stream in the divider (13) pulls the lubricant dose into the piping, divider (16), and spray nozzles (17) that apply the lubricant to the wheel flange. When the lubrication time passes, the control timer (14) interrupts the stream supply to the operating valve (9) that closes and stops the air streaming into the mixing device (13), and the control timer (14) starts measuring the lubrication pause time.

Stage 2 – Pause (covers only the tram travel time)

The pause time can be set by a switch within the range of 24 ÷ 360 sec.

Mode II – First run (filling) of the circuit

Multiple (40 x) immediate repeating of the lubrication cycle started with the tram standing, used for the first run of the circuit or after using mode III or V in order to fill the circuit as fast as possible with lubricant and convey the lubricant to spray nozzles (17). If necessary, the starting mode II is repeated.

This mode has two time–adjustable stages – stage 1 - lubrication (mixture spraying) and stage 2 - pause. Lubrication time (stage 1) can be set to 1 ÷ 15 sec. Pause time (stage 2) can be set to 6 ÷ 90 sec.

When mode II finishes, the control unit of the control timer (14) switches to mode I.

Mode III – Cylcical blowing through the circuit

Before putting the vehicle out of service for a long time, it is necessary to clean the lubrication circuit behind the mixing device (13) from lubricant by cyclical blowing. Particularly in the divider (16) and in spray nozzles (17), lubricant residues can accumulate, harden, and make the whole lubrication system unreliable. Before launching mode III, it is necessary to shut off the cock (11) of air inlet into the pneumatic lubrication pump (10). Mode III works in a cycle of 5-sec. blowing with 60-sec. pause. The total blowing time is adjustable within the range of 4 ÷ 60 min.

When mode III finishes, the control unit of the control timer (14) switches to mode I.

Mode IV – Service button

Mode IV is designed for service purposes and it serves for checking the function of the lubrication circuit, adjusting spray nozzles (17) etc. One lubrication cycle proceeds even with the tram standing, and time can be set within the range of 1 ÷ 15 sec.

When mode IV finishes, the control unit of the control timer (14) switches to mode I.

Mode V – External blowing

For faster blowing through the circuit in mode III, it is possible to connect an external source of pressure air to the quick-coupling socket (18) at the mixing device (13).
OPERATION AND MAINTENANCE

Regular inspecting and maintenance of the whole system of wheel flange lubrication is necessary for correct and reliable operation in trams.

Tightness of all connections of the air and oil circuits is checked once a month. Special attention must be paid particularly to DN4 and DN8 tubes for mechanical and other damage. Furthermore, the setting and clearness of spray nozzles (17) is checked, and damaged spray nozzles are replaced and missing nozzles are added.

The suction filter of the compressor is checked after 1000 hours of vehicle operation. If the suction filter is clogged, it must be replaced immediately.

The reservoir of the pneumatic lubrication pump (10) is filled with lubricant through the filling quick-coupler (19) located at the bottom of the lubrication pump (10). To prevent overfilling the reservoir and subsequent leakage of lubricant into the box, the lubrication pump (10) reservoir is equipped with a max. level sensor (22). When the reservoir is fully filled with lubricant it is signalled by the red indicator of max. level (23). The operator is warned about the low level of lubricant in the reservoir if the output signal “08 – Lack of lubricant” at the control timer (14) is connected to a pilot light. When lack of lubricant is signalled, the pneumatic lubrication pump allows about 1200 lubrication cycles (with lubrication cycle length of 5 minutes and a dose of 0.4 cm$^3$ per cycle this means about 50 hours of vehicle travel).

The amount of lubricant in the reservoir, which is transparent, can also be checked visually. When necessary, lubricant is added.

The necessary condition for correct functioning of the system is ensuring that the lubricant is clean when handled and added to the tank.

For adding lubricant, we recommend mobile lubricant pump types UCP, 40Z1P and 63Z1P, or the barrel lubrication pump BPO.

TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tr>
<td>Basic dose of lubricant for trams</td>
<td>0.4 cm$^3$/cycle</td>
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<tr>
<td>Fed amount regulation</td>
<td>0.2 ÷ 0.8 cm$^3$/cycle, by 0.2 cm$^3$</td>
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<tr>
<td>Lubricant reservoir capacity</td>
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<td>Pressure air tank capacity</td>
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<td>Number of outlets</td>
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<tr>
<td>Mixture outlet threaded joint</td>
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<td>Working environment temperature</td>
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<td>Box dimensions l x w x h</td>
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<tr>
<td>Weight</td>
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</table>
Legend:
1. Wheel flange lubrication box
2. Divider (16)
3. Bracket with spray nozzles (17)
4. Electronic control system - Control timer (14)
Legend:

1. D-040 Compressor, 24V DC
2. Suction filter
3. Overload valve
4. Non-return valve
5. Pressure switch - control of pressure air supply
6. Pressure air tank
7. Pressure-release valve
8. Level gauge in lubricant reservoir
9. Operating valve
10. Pneumatic lubrication pump
11. Stopcock
12. Pressure switch - control sensor
13. Mixing device
14. Switch relay
15. Quick coupler - mode III
16. Quick coupler - filling the reservoir with lubricant
17. Service button
18. Filter with condensate separator
19. MAX. level sensor
20. MAX. level signalling

INTERNAL WHEEL FLANGE LUBRICATION ARRANGEMENT

Name: Košuličova 4 Brno
Type: OK - 01

FIG. 3
WHEEL FLANGE LUBRICATION BOX

Name

Type
OK - 01

FIG. 4
Legend:

1. Base plate
2. Sliding bracket
3. Spray nozzles bracket
4. Spray nozzle
5. Elbow coupling

Name: BRACKET WITH SPRAY NOZZLES
Type: OK - 01

FIG. 6