

TRENCH CUTTER

The invention relates to a trench cutter having at least one pair of cutting wheels, at least one bearing plate on which the cutting wheels of a pair are rotatably arranged on the two sides of the bearing plate, a base frame on the underside of which the at least one bearing plate is attached, and a cutting wheel drive for driving the cutting wheels via a transmission lubricated with transmission oil in the bearing plate, according to the preamble of claim 1.

A trench cutter of the generic type is known from EP 1 637 794 B1. On this trench cutter, there is an oil circuit between the cutting wheels, which are arranged at a lower end of the bearing plate, and a frame housing having the cutting wheel drive. Oil is fed by means of the drive shaft from the cutting wheels through the cutting plate upwards to the cutting wheel drive in the housing. Oil is returned via a return conduit in the bearing plate. In operation, the bearing plate is covered on both sides by the cutting wheels and can hardly be flown around with support slurry.

A further trench cutter of the generic type is known from EP 1 580 327 B1. On this trench cutter, a drive torque of an individual drive motor is transferred via a central drive shaft in a bearing plate to a sun gear, from which the torque is distributed to the individual cutting wheel pairs.

The **object** underlying the invention is to specify a trench cutter on which a particularly high cutting performance is achieved with reliable lubrication of a transmission arrangement for driving the cutting wheels.

According to the invention, the object is achieved by a trench cutter having the features of claim 1. Preferred embodiments of the invention are specified in the dependent claims.

The trench cutter according to the invention is characterized in that at least one heat exchanger is arranged above the bearing plate and that for cooling the transmission oil, an oil circuit is formed to which the at least one heat exchanger above the bearing plate is connected.

A basic concept of the invention is based on the finding that the transmission arrangement for a trench cutter is subject to considerable forces, particularly when cutting through harder soil or stone layers, which forces can lead to an intense heating of the transmission oil. Excessive heating of the transmission oil can cause a lubricating film to break off on toothed wheels which contact one another and lead to greater wear on the toothed wheels and on the bearings. This can restrict the cutting performance and reduce the service life of the transmission.

To overcome this problem, the invention proposes providing an oil circuit having at least one heat exchanger through which the transmission oil is conducted. The heat exchanger is arranged remotely from the cutting point and from the bearing plate having the transmission, specifically is arranged above the bearing plate. The oil circuit can be created by means of oil lines.

According to the invention, there is thus effected a targeted cooling at an exposed region in the liquid-filled cut trench of the housing above the cutting wheels and above the bearing plate. This region at or even above the base frame offers the possibility of designing a very large-area wall of a preferably panel-shaped heat exchanger. A plurality of heat exchangers can also be arranged. In this way, even in the event of a very intense heating of the transmission oil in the oil circuit said oil can be cooled to a desired operating temperature so that the oil has a desired viscosity for forming a stable lubricating film during operation. As a result, high cutting performance can be achieved.

A preferred embodiment of the invention consists in that the heat exchanger is designed as a panel which is fastened in a releasable manner on the base frame or on a holding device above the base frame. The heat exchanger can thus be fastened to struts of the

base frame or to the holding device on which the base frame is suspended. The holding device can be a guide rod, a holding cable and/or supply lines.

According to a development of the invention, it is advantageous that the cutting drive is arranged in a housing, and that the heat exchanger is formed in or on an outer wall of the housing. In the case of a compact cutter, for example a CSM cutter, without guide panels, the base frame is created substantially by the housing of the cutting wheel drive. The heat exchanger here can be formed compactly on the housing.

It is advantageous that the outer wall of the housing is designed as a cooling wall, wherein to create an oil conducting channel on an inner side of the cooling wall, at least one groove is introduced in which a hose-like or tubular line is arranged. The at least one outer wall of the housing can be designed as a cooling wall in which at least one oil conducting channel is arranged, wherein oil for cooling can be conducted through the at least one oil conducting channel in the outer wall of the housing.

A preferred embodiment of the invention consists more particularly in that the oil conducting channel is formed in a loop-like, preferably in a meander-like manner in the outer wall of the housing. As a result, a particularly intense and rapid cooling of the oil in the cooling wall can be achieved.

The heat exchanger is more particularly designed as a separate panel which is fastened in a releasable manner. Thus, existing trench cutters can also be retrofitted or converted. The panel can have two parts, wherein a cover panel covers an oil conducting channel in a base panel. The cooling panel can also be placed, more particularly screwed, onto a smooth-surfaced housing wall.

According to a development of the invention, a particularly expedient embodiment is achieved in that to create the oil conducting channel on an inner side of the cooling wall, at least one groove is introduced in which a hose-shaped or tube-shaped line is arranged. The groove can run in a loop-shaped or meander-shaped manner. In principle, it is also possible to design the groove directly as an oil conducting channel by means of a corresponding sealing. The use of a hose-shaped or tube-shaped line, which can be made of

metal, preferably stainless steel, or plastic, leads to a particularly simple design with high tightness.

On the trench cutter according to the invention, particularly good cooling can be achieved in that the panel-shaped heat exchanger comprises a metal with high thermal conductivity, more particularly aluminium or an aluminium alloy. More particularly, a metal is provided which has a higher thermal conductivity than steel. As a result, a particularly intense cooling effect can be achieved. In an experiment, a cooling performance of approx. 3.2 kW was achieved when a steel panel was used, while a cooling performance of approx. 11.2 kW was achieved when an aluminium panel was used.

A further preferred embodiment of the invention consist in that at least one pump device is provided, by means of which the oil can be conveyed in the oil circuit. The pump device can be an electrically or hydraulically driven pump, preferably with a variable conveying volume. More particularly, the pump device can be driven by a control device which changes the conveying rate through the oil conducting channel depending on the current oil temperature, which can be sensed for example by a temperature sensor. A heat dissipation according to the need can thus take place.

A particularly simple design of a trench cutter according to the invention is achieved in that the pump device comprises a shaft driven by the cutting drive, which shaft is provided with a conveying helix on its outer side to create a screw pump. The shaft of the pump device can in this case be rotationally driven by the cutting wheel drive via a separate drive train.

According to a variant of the invention, it is particularly advantageous that the shaft is the drive shaft which extends from the cutting wheel drive through the bearing plate to the cutting wheels. The drive shaft runs substantially vertically and is provided on its outer side with a conveying helix, more particularly grooving, through which oil is conveyed upwards from the cutting wheels in the shaft channel along the shaft. This enables an oil conduction from the cutting wheels towards the cutting wheel drive to be adjusted without high design effort. The cutting wheel drive preferably comprises one or more hydraulic motors.

For a targeted control of the oil flow, it can be advantageous, according to a development of the invention, for a control valve to be provided, which blocks an oil conducting channel of the oil circuit at a first low temperature and unblocks the oil conducting channel at a second higher temperature. The control valve can be actuated by the already above-mentioned control depending on the oil temperature. More particularly on a start-up of the cutting wheel drive with a low temperature of the transmission oil, the oil conducting channel is blocked, so that the transmission oil is heated as quickly as possible to the operating temperature. If a second higher temperature is exceeded, the control valve can then open and release the oil conducting channel. Thus, oil can flow through the oil conducting channel into the heat exchanger, so that a corresponding cooling can be achieved.

In principle, the at least one cooling wall can be arranged at any place on the outer side of the housing or of the cutting frame. According to an embodiment of the invention, it is particularly advantageous that at least two cooling walls are provided, which are arranged on the long sides of the housing. As a result, sufficient cooling can be achieved even in the event of particularly intense heating. The housing can be designed as a lattice frame on or in which one or more cooling panels are arranged.

The invention is hereinafter described on the basis of a preferred exemplary embodiment, which is schematically illustrated in the attached drawings. The drawings show in:

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| Figure 1 | a front view of a trench cutter according to the invention; |
| Figure 2 | a schematic illustration of a partial section of the path of an oil conducting channel on the trench cutter of Figure 1; |
| Figure 3 | an enlarged partial cross-sectional view through a cooling wall for the invention; and |
| Figure 4 | a schematic illustration of part of the oil circuit on a trench cutter according to the invention. |

A trench cutter 10 according to the invention according to Figure 1 has a base frame 30 with a housing 31 on the underside of which two panel-shaped bearing plates 14 are attached. A cutting wheel 12, having a plurality of cutting teeth 13 for cutting away soil

material, is rotatably mounted on each of the two sides of the bearing plates 14. Furthermore, on the underside of the base frame 30, a wedge-shaped slurry infeed 16 can be arranged between the two pairs of cutting wheels 12. Via the slurry infeed 16, a support and cutting slurry can be introduced into the created cut trench during cutting operation. The fed slurry can be provided with a binding agent, wherein a mixing with the cut soil crushing can create a so-called soil cement, which can harden in the cut trench to create a trench wall segment.

Along the narrow sides of the base frame 30, panel-shaped adjustment and guide elements 18 are provided. During cutting operations, these can rest against the wall of the cut trench, wherein the trench cutter 10 can be guided and adjusted in the cut trench by a corresponding adjustment of the adjustment elements 18. At a top side of the housing 31 of the base frame 30, a rope suspension or a guide rod for holding and vertically adjusting the trench cutter 10 in the cut trench is provided in the known manner.

At one or preferably two long sides of the box-shaped base frame 30, a panel-shaped outer wall 32 is provided to create a heat exchanger 60, which outer wall is designed as a cooling wall 34 shown in more detail in Figures 2 and 3. The cooling wall 34 can form a wall of the housing 31.

The heat exchanger 60 with the cooling wall 34 is designed, according to Figure 3, as a flat panel preferably made of stainless steel. The cooling wall 34 has an inner side 35 facing the housing 31 and an opposite outer side 37 which in the assembled state forms an outer side of the housing 31. Along the inner side 35 of the cooling wall 34, a groove 38 is milled, which according to the depiction in Figure 2 is designed in a meander-shaped manner. A line 40 made of a metal pipe, for example copper, is inserted in this loop-shaped groove 38. The line 40 thus creates the oil conducting channel 36 in the cooling wall 34. The line 40 has, on its ends, connections 42 with which the heat exchanger 60 can be connected to an oil circuit 50, which is partially schematically shown in Figure 4.

According to the highly schematic depiction in Figure 4, a partially indicated cutting wheel drive 20 having numerous bearings is shown. From the cutting wheel drive 20, for each bearing plate 14 a merely partially shown drive shaft 22 extends downwards to the cutting

wheels 12 located below. The drive shaft 22 is provided, on its outer side, with conveyor grooves, not shown, which can convey a transmission oil from the region of the cutting wheels 12 upwards towards the cutting wheel drive 20. In the process, the oil flows through the bearings and toothed wheel arrangement of the merely schematically indicated cutting wheel drive 20. The cutting wheel drive 20 can preferably comprise at least one hydraulic motor and an output and distribution transmission.

Via a pump device, not shown, at least a part of the transmission oil is conducted via a feed line 44 of an oil circuit 50 to an upper connection of the heat exchanger 60 with a meander-shaped oil conducting channel 36 in the cooling wall 34. The heated oil in the cooling wall 34 can flow through the meander-shaped oil conducting channel 36 from the top downwards and in this process dissipate heat to the cooling wall 34 with its free outer side directed towards the slurry-filled trench. In the cooling wall 34, the oil conducting channel 36 can be designed with a slight incline of for example approximately 15° , so that an oil flow can be set without great pressure effort.

Via a return line 46 of the oil circuit 50, the cooled transmission oil is conducted back to the cutting wheel drive 20. Via a return conduit 52, the transmission oil can be conveyed from the cutting wheel drive 20 downwards to the cutting wheels with the distribution transmission. The oil which heats up again more particularly in the region of the distribution transmission can then again be conveyed upwards via the conveying action of the drive shaft 22 to the cutting wheel drive 20 and to the heat exchanger 60 above the bearing plate 14. To control the oil flow through the oil conducting channel 36, a control valve 28 is provided on the feed line 44 or, as shown, on the return line 46. At intended temperatures, said control valve can control the flow of oil through the oil conveying channel 36 and completely block or release same. Control is carried out in this process depending on temperature sensors, not shown, which measure a temperature of the transmission oil at one or a plurality of places in the oil circuit 50. The cooling circuit can also have a branch for pressure compensation of the transmission arrangement.

CLAIMS

1. Trench cutter, comprising
 - at least one pair of cutting wheels (12),
 - at least one bearing plate (14) on which the cutting wheels (12) of a pair are rotatably arranged on the two sides of the bearing plate (14),
 - a base frame (30) on the underside of which the at least one bearing plate (14) is attached, and
 - a cutting wheel drive (20) for driving the cutting wheels (12) via a transmission lubricated with transmission oil in the bearing plate (14),characterized
 - in that at least one heat exchanger (60) is arranged above the bearing plate (14), and
 - in that for cooling the transmission oil, an oil circuit (50) is formed to which the at least one heat exchanger (60) is connected above the bearing plate (14).
2. Trench cutter according to claim 1,
characterized
in that the heat exchanger (60) is designed as a panel which is fastened in a releasable manner on the base frame (30) or on a holding device above the base frame (30).
3. Trench cutter according to claim 1 or 2,
characterized
in that the cutting drive (20) is arranged in a housing (31), and
in that the heat exchanger (60) is designed in or on an outer wall (32) of the housing (30).

4. Trench cutter according to claim 3,
characterized
in that the outer wall (32) of the housing (31) is designed as a cooling wall (34),
wherein to create an oil conducting channel (36) on an inner side of the cooling
wall (34), at least one groove (38) is introduced in which a hose-shaped or tube-
shaped line (40) is arranged.
5. Trench cutter according to one of claims 1 to 4,
characterized
in that the panel-shaped heat exchanger (60) comprises a metal with high thermal
conductivity, more particularly aluminium or an aluminium alloy.
6. Trench cutter according to one of claims 1 to 5,
characterized
in that at least one pump device is provided via which the oil can be conveyed in
the oil circuit (50).
7. Trench cutter according to claim 6,
characterized
in that the pump device comprises a shaft driven by the cutting wheel drive (20),
which shaft is provided with at least one conveying helix on its outer side.
8. Trench cutter according to claim 7,
characterized
in that the shaft is the drive shaft (22) which extends from the cutting wheel drive
(20) through the bearing plate (14) to the cutting wheels (12).
9. Trench cutter according to one of claims 1 to 8,
characterized
in that a control valve (28) is provided which blocks an oil conveying channel (36)
of the oil circuit (50) to the heat exchanger (60) at a first low temperature and re-
leases the oil conveying channel (36) at a second higher temperature.

10. Trench cutter according to one of claims 1 to 9,
characterized
in that at least two cooling walls (34) are provided which are arranged on the long
sides of the housing (30).