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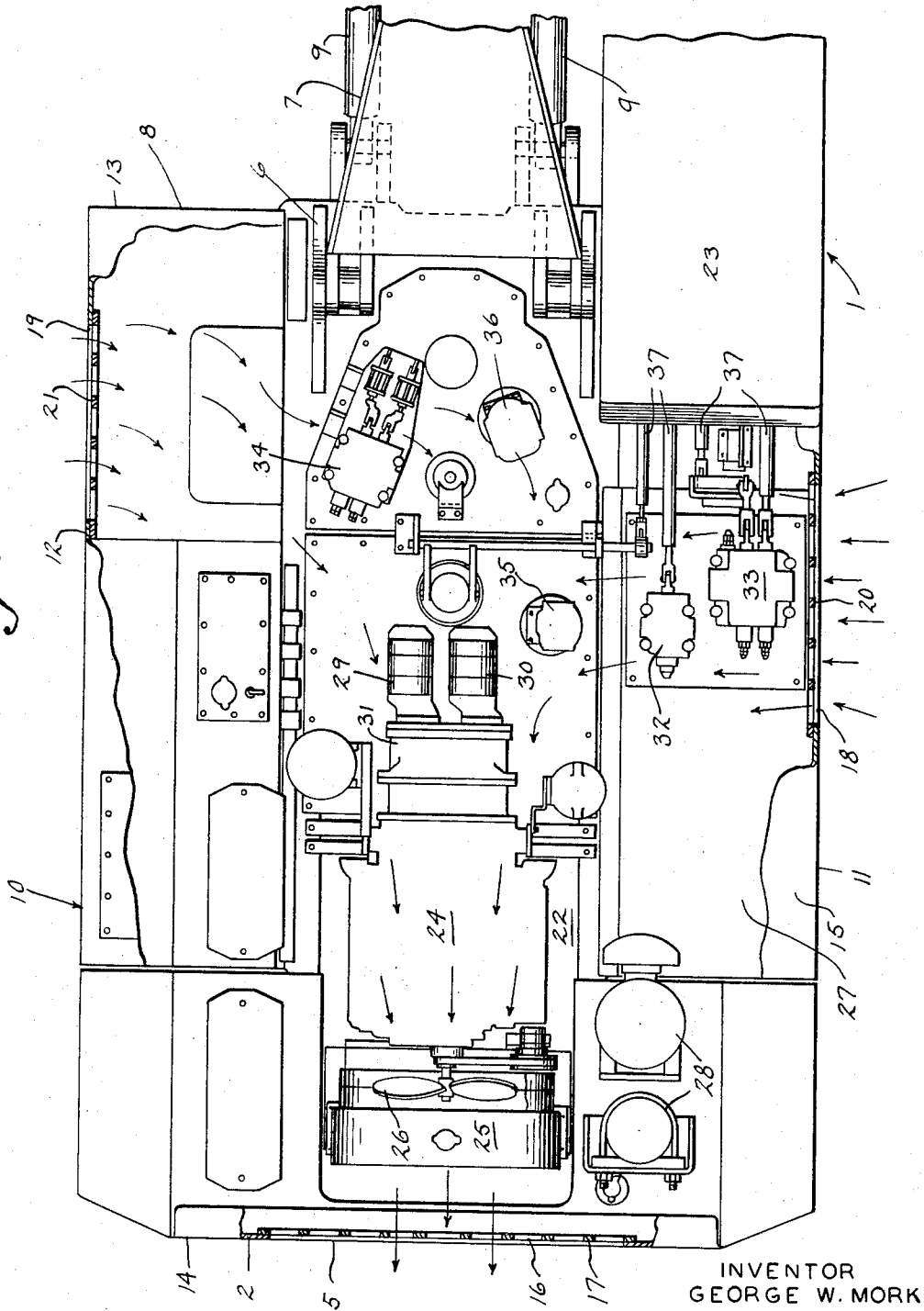
3,404,732

EXCAVATOR COOLING SYSTEM

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Fig. 1



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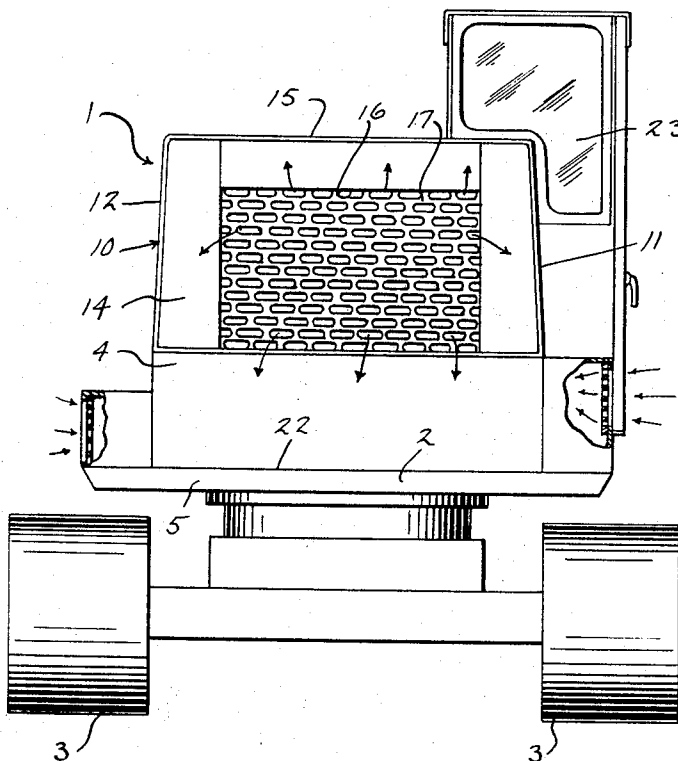
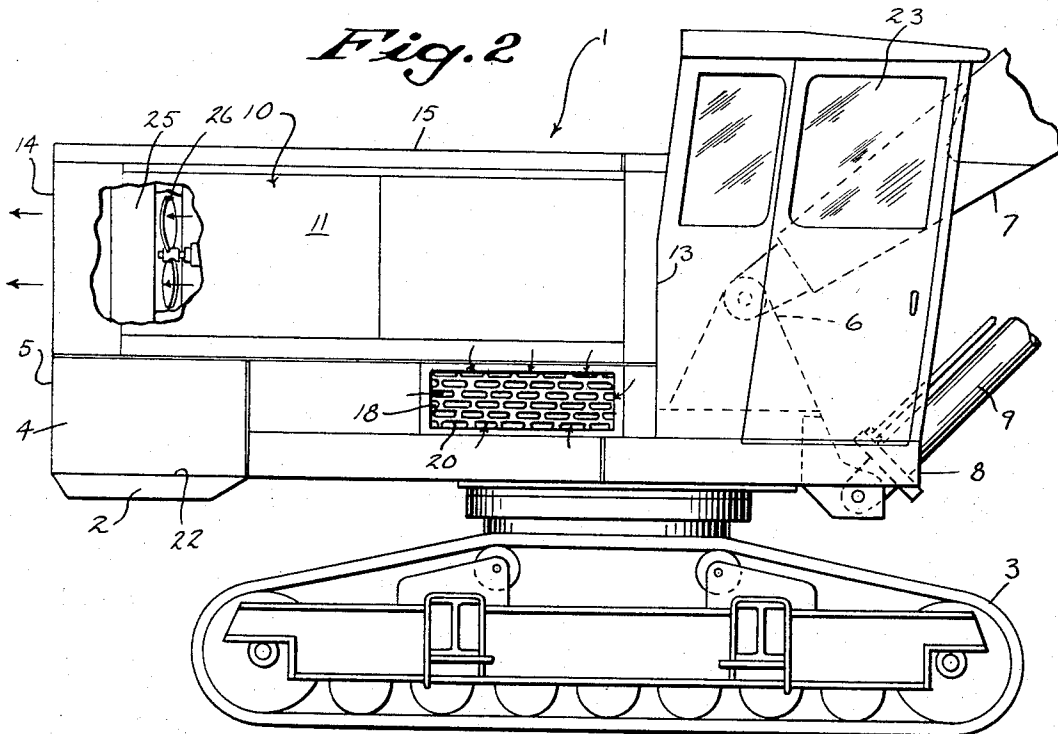
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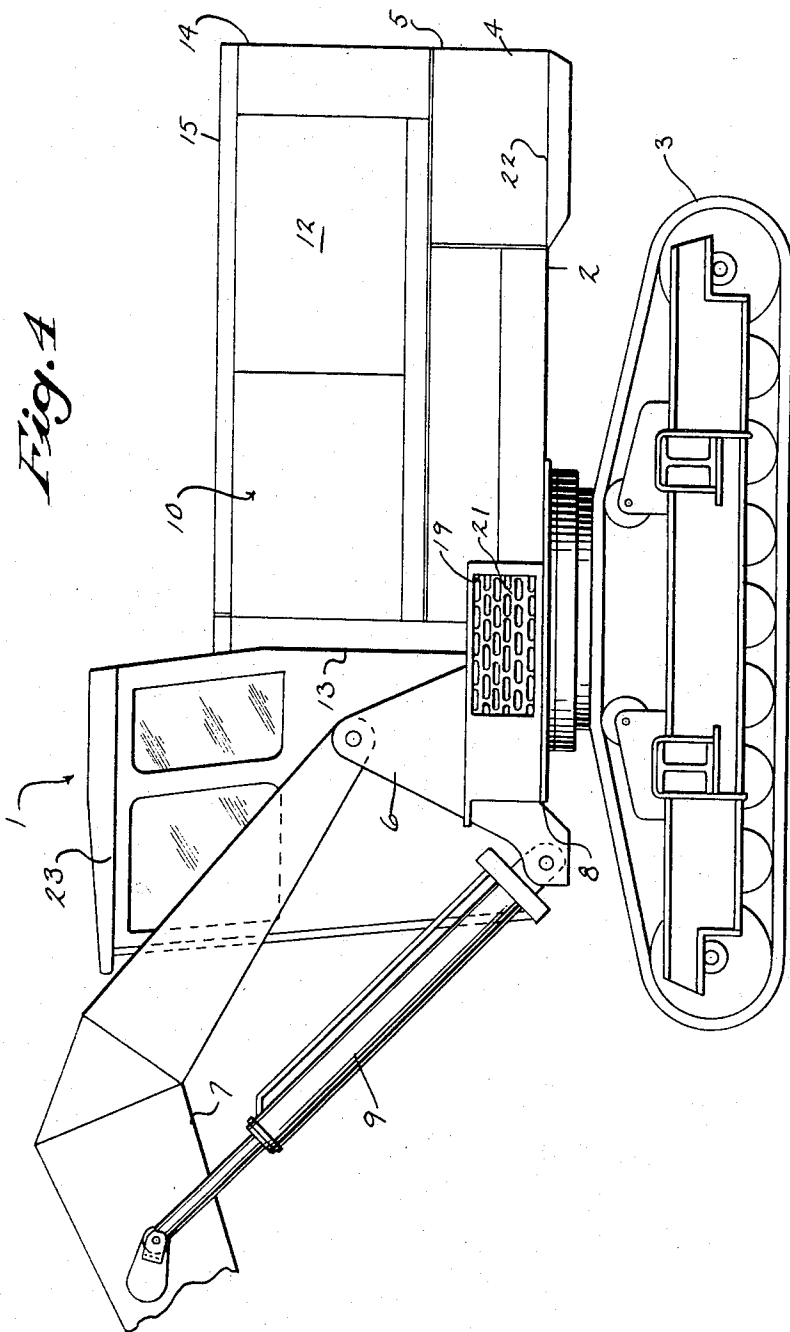
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EXCAVATOR COOLING SYSTEM

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3 Sheets-Sheet 3



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3,404,732

EXCAVATOR COOLING SYSTEM

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ABSTRACT OF THE DISCLOSURE

An hydraulic excavator powered by a liquid cooled diesel is described. The diesel and the principal hydraulic components are sealed in a housing except for two air inlet ports on opposite sides near the front and an outlet port in the back. The diesel is mounted in the back with the hydraulic components in front of it, so that air drawn by the fan of the diesel cools the hydraulic components.

Background of the invention

In hydraulic excavators and cranes, great quantities of heat are generated in the hydraulic system and absorbed in the hydraulic fluid. If the heat generated in the hydraulic system is not dissipated, it will increase the temperature of the oil to beyond its breakdown point, and it could be damaging to the hydraulic components of the system. Therefore, it has been customary in the past to provide large heat exchangers for cooling the hydraulic fluid, and to open the machinery housing of the excavator during use so as to expose the hydraulic equipment as much as possible to the ambient air. The heat exchangers required to provide the necessary cooling are very expensive. Moreover, they occupy precious space in the machinery housing of the excavator, and they add substantially to the weight and power requirements of the hydraulic system. The present invention has, in many cases, obviated the need for additional heat exchangers for the hydraulic equipment altogether, and in others it has greatly reduced the size and cost of the heat exchangers required. Generally speaking, this is accomplished by employing the air flow generated for the radiator of the prime mover engine to cool the hydraulic apparatus. While this invention requires an increase in the capacity of the cooling system of the engine, due to the elevated temperature of the air coming from the hydraulic equipment, this addition is miniscule when compared with the amount of otherwise needed cooling equipment for the hydraulic fluid that has been eliminated.

The prior art directly related to the invention, as was mentioned above, involves the use of special heat exchangers and simple exposure of the hydraulic equipment. Structure superficially similar to the present invention evolved out of the necessity to cool the engines in sealed military vehicles such as amphibians, U.S. Patents Nos. 2,341,165 and 2,416,128, and military tanks, U.S. Patents Nos. 2,853,153 and 2,435,513, as well as in engine cowling for a radial engine, U.S. Patent No. 1,925,415. The inventions of the cited patents relating to the military vehicles all provide solutions to the problem of getting air to the radiator of an engine which must be sealed against damage from its environment. The engine of a tank must be secured against enemy fire and the engine of an amphibian must be secured against water leakage, and the problem

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arises because the engine cannot be exposed to the air through which the vehicle is moving, as is taught in Patent No. 1,925,415 cited above, and as is employed generally in motor vehicles. But the teachings of those patents do not respond to the needs met by the present invention.

Summary of the invention

The present invention, therefore, relates to a cooling system for hydraulic fluid in an hydraulic excavator and, more specifically, the invention resides in the combination in an excavator having a completely enclosed machinery housing containing an engine with a radiator and a fan and at least part of an hydraulic power unit for operating the hydraulic excavator mounted in the machinery housing and aligned between an air inlet port and an air outlet port formed in the walls of the machinery housing so that the air drawn through the housing by the engine fan will cool said part of the hydraulic power unit.

Brief description of the drawings

FIG. 1 is a top plan view of a revolving frame of an hydraulically operated back hoe showing the location of the prime mover engine and the main components of the hydraulic power unit.

FIG. 2 is a side elevation of the hydraulic back hoe shown in top plan view in FIG. 1 with most of the boom structure broken away.

FIG. 3 is a rear elevation of the back hoe shown in FIGS. 1 and 2.

FIG. 4 is a side elevation of the back hoe shown in FIGS. 1 through 3 from the opposite side of that shown in FIG. 2 with most of the boom broken away.

Description of the preferred embodiment

Referring initially to FIG. 2 and FIG. 4, a back hoe type of excavator 1 having a revolving frame 2 which is rotatably mounted on crawler type running gear 3 for propulsion is shown. The revolving frame 2 supports a counter weight 4 on its back end 5, and a boom pedestal 6 with a boom 7 pivotally mounted thereon on its front end 8. To control the elevation of boom 7 a pair of hydraulic hoist cylinders 9 are also shown, although the remainder of the boom 7 with its excavating implement and other gear has been omitted to allow maximum enlargement of the portion of the excavator relating directly to the invention. Of course, many forms of boom 7 with associated hydraulic equipment and implements are well known to the art, so disclosure of any specific boom structure may be omitted here since that specific structure is not pertinent to this invention. Moreover, it should also be noted here that the invention is not limited to back hoes, and the term "excavator" when used to describe or claim this invention is intended also to include cranes.

The revolving frame 2 supports a machinery housing 10 which is completely enclosed by side walls 11 and 12, front wall 13, back wall 14 and a roof 15. Conventionally, the housing 10 may be stamped from sheet metal, although most of the other types of construction employed with motor vehicles can also be used here. An opening is formed in the back wall 14 as an air outlet port 16, and it

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is fitted with a protective grill 17. In each of the side walls 11 and 12, toward the front end of the machinery housing 10, air inlet ports 18 and 19 are formed, and these also are fitted with protective grills 20 and 21, respectively. Since the air outlet port 16 must be located above the counter weight 4, it is close to the roof 15 of the machinery housing 10, whereas the air inlet ports 18 and 19 are located just above the floor 22 on the revolving frame 2 at the front lower corners of the side walls 11 and 12, and hence they are at a lower level than the outlet port 16. An enclosed operator's cab 23 is mounted on the right hand side of the revolving frame 2 immediately in front of the machinery housing 10.

FIG. 1 illustrates the layout of the machinery and equipment on the revolving frame 2. A liquid-cooled, V-6 diesel engine 24 is mounted on the center of the revolving frame 2 toward its back end 5. Between the diesel engine 24 and the air outlet port 16, which is directly aligned with and just behind the diesel engine 24, is a radiator 25 for the cooling liquid for the diesel engine 24. Between the radiator 25 and the diesel engine 24 is fan 26, which is driven by the diesel engine 24 for propelling cooling air through the radiator 25. On each side of the diesel engine 24, tanks 27 are mounted on the revolving frame 2 for storing hydraulic fluid and fuel oil. Also, certain other auxiliary equipment 28 is mounted next to the diesel engine 24 on the revolving frame 2. A pair of hydraulic pumps 29 and 30 are mounted on the front end of a transmission 31, which in turn is mounted on the front end of the diesel engine 24 for transmitting driving power from the diesel engine 24 to the pumps 29 and 30. In front of the tanks 27 on the right hand side of the machinery housing 10 are mounted a pair of hydraulic valves 32 and 33, and another hydraulic valve 34 is mounted just left of center on the revolving frame 2 in front of the diesel engine 24. The hydraulic valves 32, 33 and 34 are the principal valves of the hydraulic power unit and these control the propulsion and swing as well as the other excavating operations. A pair of hydraulic motors 35 and 36 are also mounted on the revolving frame 2 in the machinery housing 10 in front of the diesel engine 24 with its hydraulic pumps 29 and 30. As is appreciated by anyone who has ever seen an hydraulic excavator, the hydraulic pumps 29 and 30 are inter-connected with the hydraulic valves 32, 33 and 34 and the hydraulic motors 35 and 36 by numerous, large capacity, high pressure hydraulic conduits, which are omitted here from the drawings in order to avoid presenting a confused tangle of lines that would only obfuscate the disclosure. However, this vast footage of conduit also contains a great deal of oil which is cooled in the same manner as the oil in the components 29, 30, 32-36 shown here. These hydraulic components and the associated conduits constitute the main part of the hydraulic power unit for driving the excavator. The hydraulic valves 32 through 34 are connected to controls in the operator's cab 23 by means of mechanical linkages 37, some of which are represented here and some of which are not.

Whenever the excavator 1 is operating, the diesel engine 24 is running and driving the fan 26. The fan 26 will draw air through the inlet ports 18 and 19, as indicated by the small arrows in the drawings, and over the portion of the hydraulic power unit including the components 29-36 shown here. The air passing over the hydraulic components 29-36 and conduits will serve to cool them, and thus the hydraulic fluid in them to maintain the hydraulic fluid within its prescribed temperature range. Of course, the air, receiving heat from the hydraulic power unit, will be unable to cool the liquid in the radiator 25 of the diesel as efficiently as otherwise. Hence, the cooling capacity of the radiator 25, or the capacity of the fan 26, or both, should be increased commensurately.

In the past it has been customary to open the sides

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of the machinery housing 10 whenever the excavator 1 was in operation to allow for maximum cooling of the diesel engine 24 and any other equipment in the machinery housing 10. Hereafter, with the application of the present invention it will be imperative to keep the machinery housing 10 completely closed except for the air ports 16, 18 and 19 so as to preserve the controlled air flow through the air duct created by the machinery housing 10. Of course, in the past it has also been necessary to employ large and expensive heat exchangers with separate fans for cooling the hydraulic fluid, but in embodiments such as the one described here, such heat exchangers may be omitted entirely and in other embodiments the size and cost of the heat exchangers still required may be drastically reduced. Not only is the overall efficiency of the excavator substantially increased, but the sealing of the machinery housing 10 also permits filtration of the cooling air and cleanliness around the machinery and equipment and sharply reduced operating noise level. The isolation of the operator from the noise and distraction of the machinery both improves working conditions and renders the use of such equipment safer. All of these objects and advantages may be obtained through the invention set forth in the following claims.

I claim:

1. A cooling system for hydraulic fluid in combination with a hydraulic excavator comprising

a revolving frame for supporting powered machinery for driving said hydraulic excavator;
an enclosed operator's cab for housing an operator and controls;

a machinery housing separate and isolated from said operator's cab, mounted on said revolving frame and being completely enclosed by walls including side walls, a front end wall, a back end wall, a floor, and a roof;

an air outlet port through one of said walls of said machinery housing;

at least one air inlet port through another of said walls of said machinery housing;

said walls of said machinery housing along with said air inlet port and said air outlet port forming an air duct through said machinery housing;

an engine mounted inside said air duct in said housing and having a radiator adjacent said air outlet duct and a fan mounted to draw air through said air inlet duct over said engine and forcing said air through said radiator and out said air outlet duct;

and at least part of a hydraulic power unit for driving said hydraulic excavator being mounted in said air duct in said housing between said engine and said inlet port.

2. A cooling system for hydraulic fluid in combination with a hydraulic excavator as set forth in claim 1 wherein said engine is mounted near said back end wall of said machinery housing and substantially centered in said machinery housing;

fuel and hydraulic fluid tanks and other auxiliary equipment are mounted between said side walls of said machinery housing and said engine;

said air outlet port is located in said back end wall of said machinery housing;

and said radiator is mounted adjacent said air outlet port with said fan mounted between said engine and said radiator.

3. A cooling system for hydraulic fluid in combination with a hydraulic excavator as set forth in claim 2 wherein said part of said hydraulic power unit is mounted in front of said engine and on a lower level than said engine;

and air inlet ports are formed in opposite side walls of said machinery housing adjacent to said hydraulic power unit and at a lower level than said air outlet port.

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4. A cooling system for hydraulic fluid in combination with a hydraulic excavator as set forth in claim 1 wherein

said frame is a revolving frame supported for propulsion on crawler type running gear;

said operator's cab is mounted on said revolving frame in front of said machinery housing;

and said part of said hydraulic power unit includes hydraulic pumps driven by said engine and principal control valve units with associated manifolds and piping for hydraulic fluid.

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