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Tranquilla et al.

[11] **3,771,478**

[45] **Nov. 13, 1973**

[54] **SEWING MACHINE COOLING SYSTEM**

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[52] **U.S. Cl.** .... **112/218 R,** 112/256

[51] **Int. Cl.** **D05b 71/00**

[58] **Field of Search** .... 112/218 R, 256; 416/60

[56] **References Cited**

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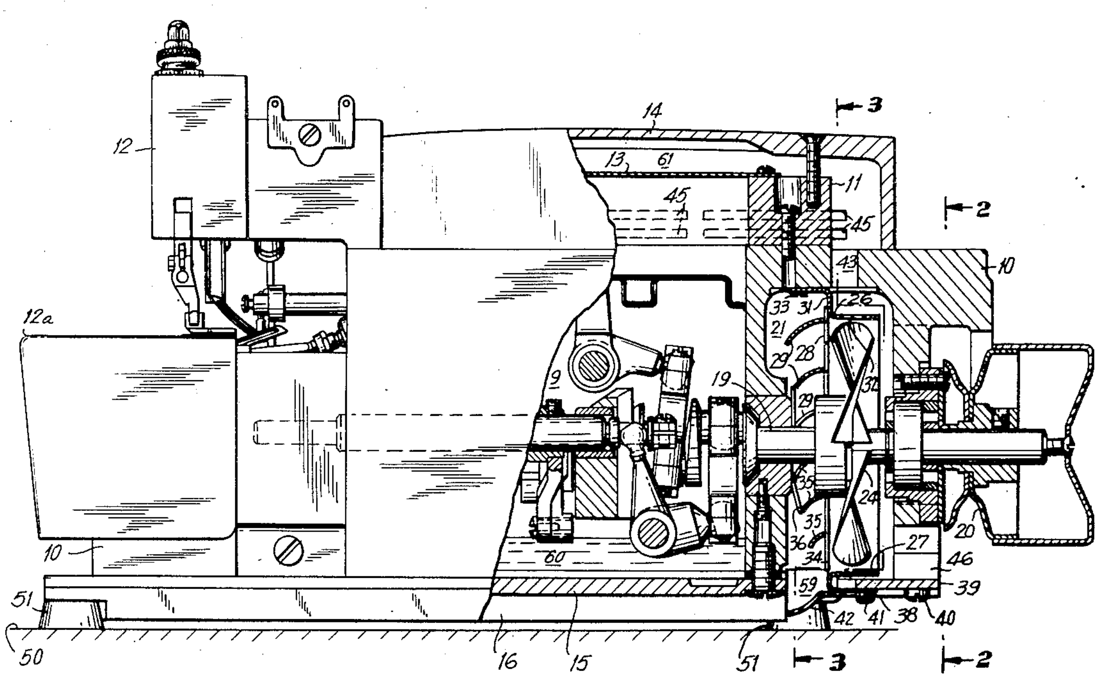
Primary Examiner—H. Hampton Hunter

Attorney—John A. Howson et al.

[57] **ABSTRACT**

A sewing machine is provided with a ducted fan mounted on the machine drive shaft. The fan provides a substantially axial flow. Air discharged from the fan is directed over the bottom cover plate of the sewing machine which is provided with heat dissipating fins. Additionally, air discharged from the fan is directed over the top of the machine.

15 Claims, 5 Drawing Figures



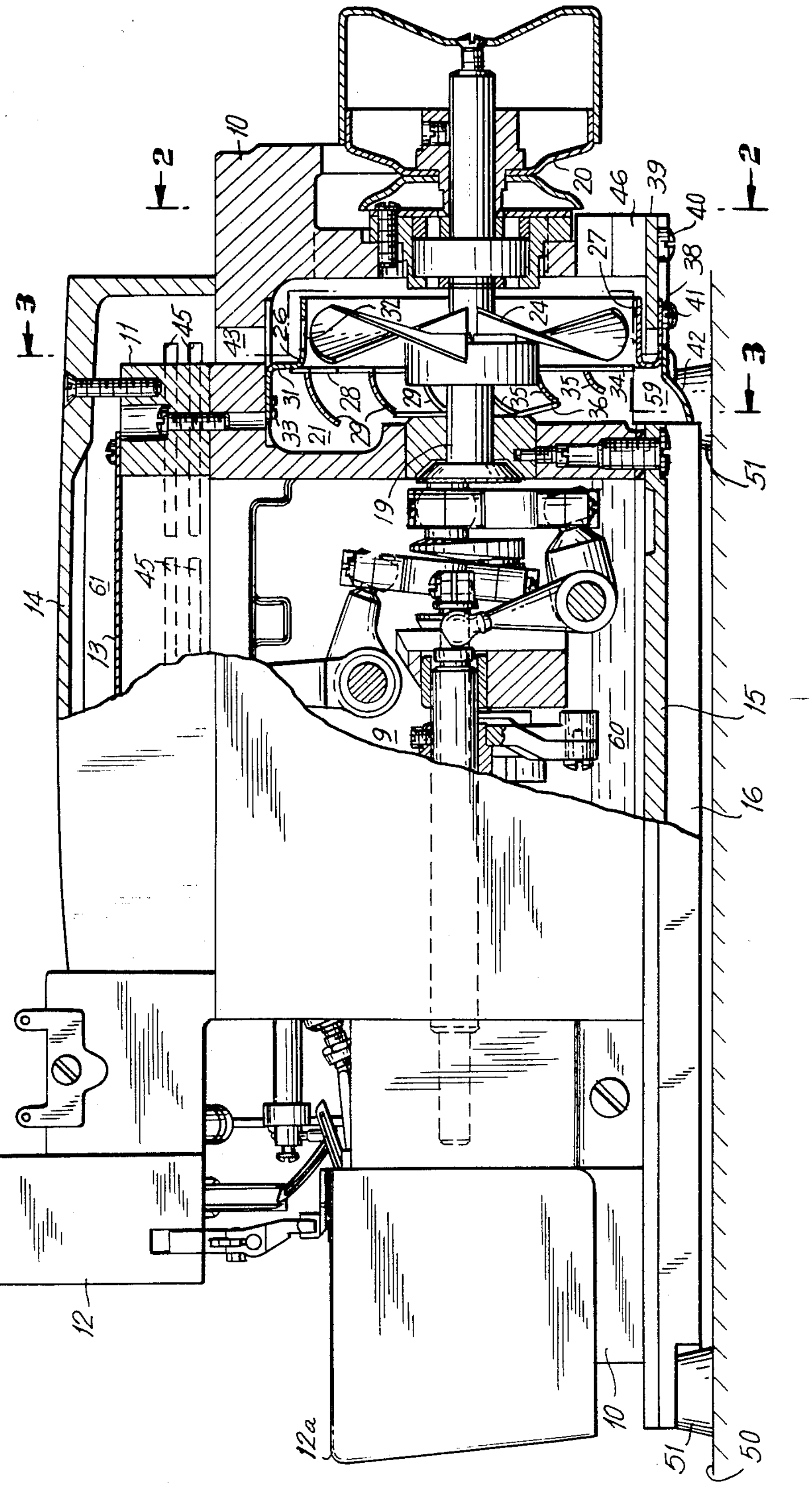

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FIG. 1

FIG. 2

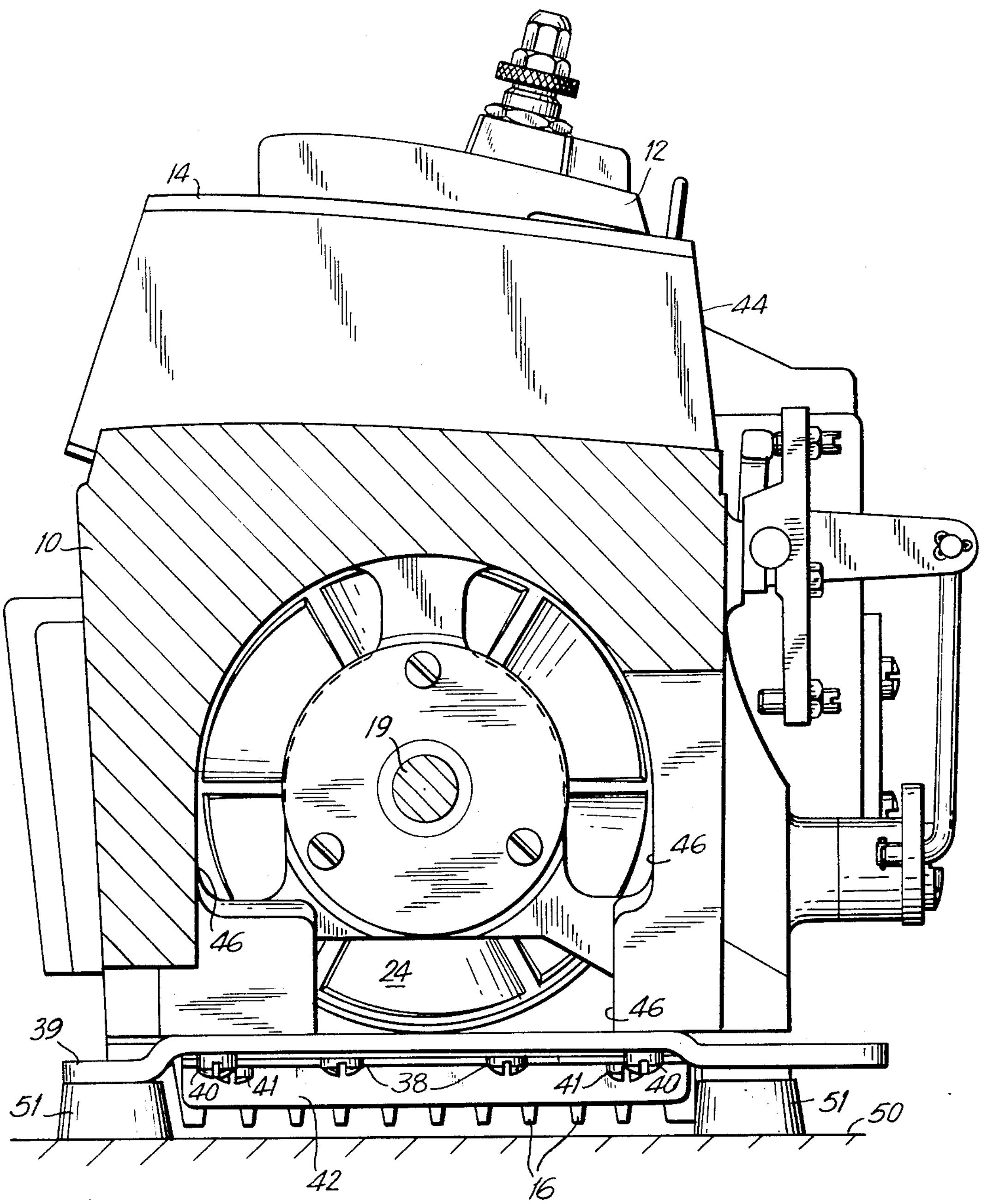


FIG. 3

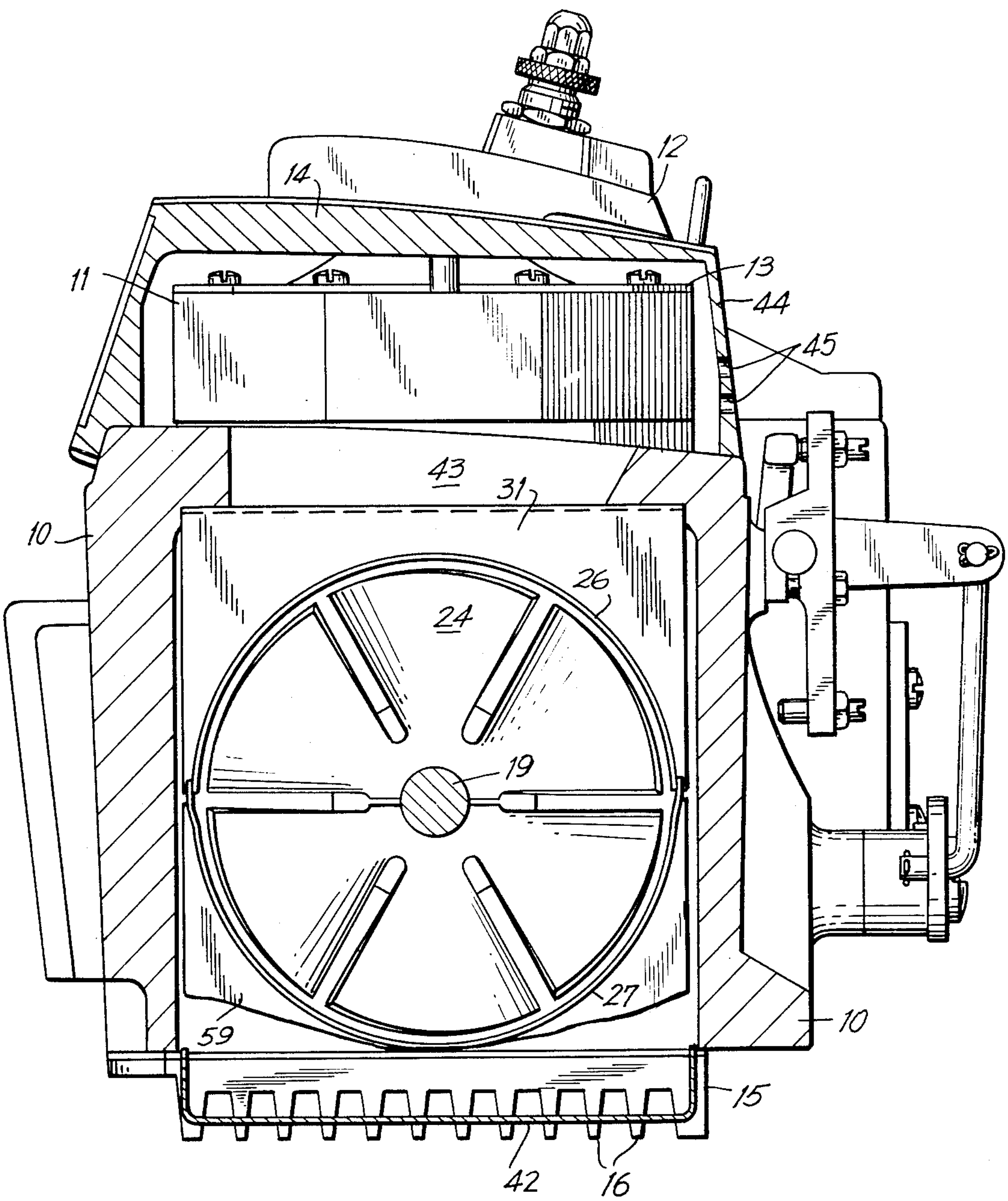
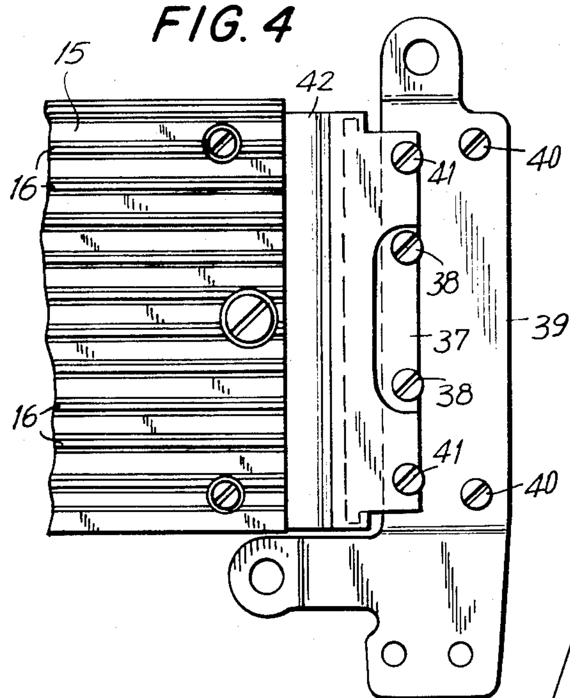


FIG. 4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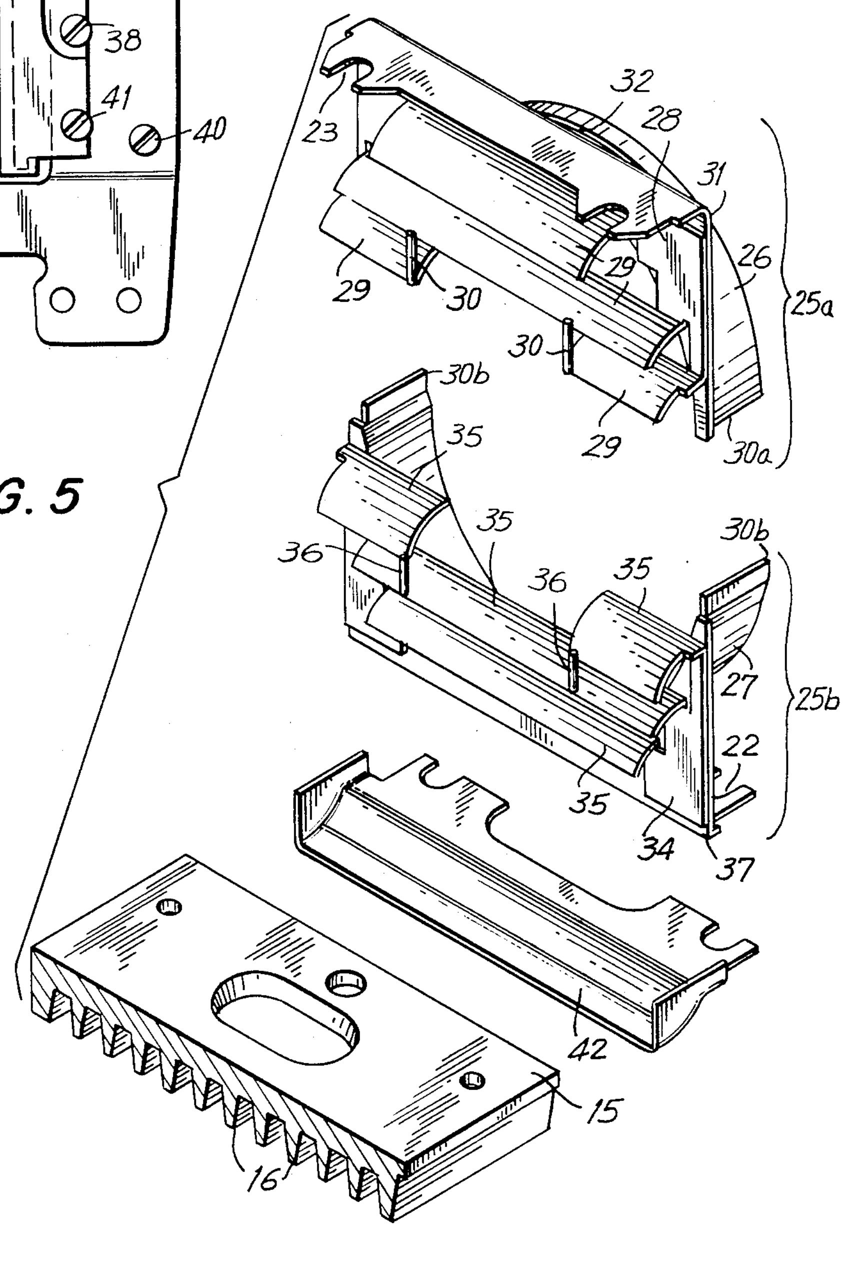
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FIG. 5

SEWING MACHINE COOLING SYSTEM

BACKGROUND OF THE INVENTION

1. Field to Which the Invention Pertains

This invention pertains to sewing machines and particularly to a cooling system for a sewing machine.

Sewing machines, particularly industrial sewing machines, often operate at extremely high speeds, e.g., industrial sewing machines are available which run at speeds as high as 8,000 rpm. Since such machines employ numerous mechanical parts which are in moving contact, sophisticated lubrication systems are necessitated. Notwithstanding the sophistication of these lubrication systems, a substantial amount of heat is generated when the various mechanical parts of the sewing machine operate at such high speeds. Generally, such frictionally generated heat is manifested by an increase in both the temperature of the oil and the temperature of the various mechanical parts and frame which comprise the machine. For a number of reasons, it is important that some of this heat is dissipated. For example, if a cooling system is not provided to dissipate some of this heat, the lubricating oil may suffer a thermal degradation with the result that the required lubrication will not be provided. Additionally, the temperature of the exterior members of the sewing machine must be limited in order to insure both the safety and comfort of the operator.

A novel cooling system for dissipating such frictionally generated heat is the field to which this invention pertains.

2. Prior Art

The prior art has recognized the need for providing a cooling system for a sewing machine and particularly the need for providing a cooling system in conjunction with high speed, industrial sewing machines. Thus, various sewing machine constructions and apparatus arrangements have heretofore been proposed for providing a cooling or heat dissipating effect. Exemplary of such prior art constructions are the cooling systems shown in U.S. Pat. Nos. 3,638,594; 2,678,013; 2,744,482; 3,081,723; 2,222,016; 3,009,430 and 2,711,146.

A common expedient disclosed in some of the aforementioned patents are used by the prior art to dissipate heat generated in a sewing machine comprises the use of heat dissipating fins exteriorally mounted on a sewing machine, for example on the base thereof. Another approach employed by the prior art to provide heat dissipating effects resides in the utilization of a fan for creating air flows within or around the sewing machine. Although these and other prior art constructions provided a degree of cooling or heat dissipation, it has been found that prior art cooling systems are not sufficiently effective when employed in combination with sewing machines operating at speeds on the order of 7,000 to 8,000 rpm. Thus, at such speeds, the lubricating oil within the machine and the external frame members are heated to undesirably high temperatures notwithstanding the use of prior art cooling systems. However, through the use of the cooling system disclosed herein, it has been found that the temperature of the lubricating oil and the temperature of the external members of the machine may be significantly reduced.

SUMMARY OF THE INVENTION

In combination with a sewing machine having a main chamber wherein there is located the mechanical parts for operating the machine, there is provided a second chamber adjacent to the machine chamber at one end of the machine. The machine drive shaft extends through both the machine chamber and the second chamber and is provided with means adapted for external drive, e.g., a pulley mounted on the end of the drive shaft exteriorally of the machine. Mounted on the drive shaft in the second chamber is a ducted fan which provides a substantially axial flow.

In the preferred embodiment of the invention, the second chamber is provided with an air inlet port and two discharge ports, one at the top of the second chamber and one at the bottom of the second chamber. Air which is axially discharged from the fan is directed downwardly, by louvers, to the bottom discharge port. Located at the bottom discharge port is a horizontally disposed louver which redirects the downwardly flowing air to a horizontal path. Air discharged from the second louver flows along and between heat dissipating fins which are mounted on the bottom cover plate of the machine and disposed longitudinally thereof.

Air from the ducted fan may also be directed along and over the top of the machine. In the preferred embodiment of the invention, air flow over the top of the machine is achieved by providing a slot in the top of the duct associated with the ducted fan. A portion of the air handled by the fan is discharged through the aforementioned slot which is located adjacent to the top discharge port in the second chamber. To insure that air flowing through the top discharge port is conducted over the top of the machine, a top cover is provided in the preferred embodiment which defines a sealed chamber with respect to the top of the machine. The top cover is provided with slots, preferably at the rear thereof, through which air may be discharged.

To obtain optimum cooling, means are provided adjacent to the bottom of the heat dissipating fins for maintaining the air flow between the fins.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view, partially in section, of a sewing machine and showing a preferred embodiment of the invention.

FIG. **2** is a side view, partially in section, taken along the section line **2—2** of FIG. **1**.

FIG. **3** is a side view, partially in section, taken along the section line **3—3** of FIG. **1**.

FIG. **4** is a fragmentary, bottom view of the sewing machine shown in FIG. **1**.

FIG. **5** is a view in perspective of certain parts of the sewing machine shown in FIG. **1**, said parts being shown in spaced, disassembled arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring to FIG. **1**, there is shown a sewing machine of the over-edge type. The machine includes an upstanding frame **10** which defines a machine chamber **9** and a second chamber **21**. Bolted to the upstanding frame **10** is an upper frame **11**. The machine chamber **9** is sealed at the top by a top oil cover plate **13** appropriately bolted to the upper frame **11**. Mounted on the upper frame **11** is an operating head **12**. Affixed to the lower portion of the frame **10** is an operating table **12*a***. The machine chamber **9** is sealed at the bottom by a bottom cover plate **15**. As an integral part of the bottom cover plate 15, there are provided a plurality of heat dissipating fins 16 longitudinally disposed along the bottom of the bottom cover plate 15 as most clearly seen in FIGS. 2 and 3. Referring again to FIG. 1, a drive shaft 19 is mounted on the frame 10 longitudinally thereof and is appropriately journaled for rotation. The drive shaft 19 extends through the machine chamber 9 and the second chamber 21 and extends beyond the frame 10, at the right side thereof, where it is adapted for external drive, i.e., the drive shaft 19 is provided with a pulley 20. Those skilled in the art will appreciate that within the machine chamber 9 there is located the various mechanical means for providing an operative connection between the drive shaft 19 and the operating head 12 as well as the operating table 12*a*. Similarly, it will be appreciated that when a machine such as the one shown in FIG. 1 is in operation, a reservoir of lubricating oil 60 (shown in FIG. 1) is provided for lubricating the mechanical parts which provide the operative connection between the drive shaft 19 and the operating head 12. Typically, various means are provided, and are well known to those skilled in the art, to cause oil from the reservoir to be deposited upon the various mechanical parts mounted within the machine chamber 9. Thus, in operation, the environment defined by the machine chamber 9 will be heated and the oil which drips off the moving parts will be deposited at the bottom of the machine chamber 9. Hence, for purposes of description, it will be assumed that the oil reservoir 60 and the surfaces which define the machine chamber 9, e.g., the top oil cover plate 13, are at an elevated temperature.

Referring to the second chamber 21, it will be observed that there is provided an inlet port 46 and two discharge ports, viz a top discharge port 43 and a bottom discharge port 59. Within the second chamber 21, a fan 24 is provided and is constructed so as to provide a substantially axial flow. Additionally, it will be observed that fan 24 is a ducted fan, i.e., referring to FIG. 3, a duct peripherally surrounds the fan 24. Referring to FIGS. 1 and 5, it will be seen that the duct which peripherally surrounds the fan 24 is comprised of a top duct 26 and a bottom duct 27. The top duct includes an inverted L shaped plate 31 provided with screw receiving slots 23 on the horizontal surface thereof. Thus, the entire upper duct assembly 25a is maintained in position within the chamber 21 by affixation to the frame 10, for example by the use of bolts 33 as shown in FIG. 1. As seen in FIG. 5, the plate 28 includes a plurality of downwardly facing louvers 29. The plate 29 is affixed to the plate 31, for example by welding.

Similar to the construction of the upper duct assembly 25*a* the lower duct 27 includes an L-shaped plate 37 provided with bolt receiving slots 22. In this manner, the lower duct assembly 25b may be secured within the second chamber 21 (as shown in FIGS. 1 and 2) by screws 38. Referring again to FIG. 5, the plate 34 includes a plurality of downwardly facing louvers 35. Plate 34 is fixedly mounted on the plate 37, for example by welding. For added strength, support pins 30 and 36 may be provided for louvers 29, 35, respectively.

It will be noted that the terminal edges 30*b* of the bottom duct 27 are crimped for engagement with the terminal edges 30*a* of the upper duct 25*a*.

Referring to FIGS. 1, 4 and 5, it will be seen that there is provided a horizontally disposed louver 42 which is affixed by screws 41 to plate 39, plate 39 being affixed to the frame 10 by screws 40. As best seen in FIG. 1, the louver 42 terminates adjacent to the transverse edges of the longitudinally disposed fins 16.

Referring to FIGS. 1 and 3, top cover plate 14 is mounted on the frame 10 and together with the top oil cover plate 13 provides a substantially sealed chamber 61. It will be noted that the substantially sealed chamber 61 is in fluid communication with the second chamber 21 via the top discharge port 43. Additionally, it will be noted that the top cover plate 14 is provided with a plurality of slots 45 at the rear thereof.

Referring again to FIGS. 1 and 5, it may be observed that a slot 32 is provided in the top portion of the upper duct 26 and is located (FIG. 1) adjacent to the top discharge port 43.

When the sewing machine of FIG. 1 is operated, a belt is disposed about the pulley 20 and connected to an electric motor which supplies the necessary power to rotate the drive shaft 19. Rotation of the main drive shaft 19 rotates the fan 24 which inducts air into the second chamber 21 through the intake port 46. Because of the presence of fan duct 26, 27 and because the fan 24 is substantially an axial flow fan, the preponderance of the air conducted into he chamber 21 is axially discharged and thus directed against the downwardly facing louver 29, 35. Thus, the air axially discharged from the fan 24 is directed downwardly through the left hand side of the second chamber 21 towards the bottom discharge port 59, where it encounters the horizontally disposed louver 42 and is thus redirected into a horizontal flow between the longitudinally disposed fins 16.

Although the fan 24 provides a substantially axial flow, a radial flow component is nevertheless imparted to some of the air which is handled by the fan 24. Thus, a radial pressure head is developed which causes air to flow through the slot 32 and then through the adjacently disposed top discharge port 43. In this manner, an air flow is maintained into the substantially sealed chamber 61. Air flowing into this substantially sealed chamber 61 passes over the top oil cover plate 13 and is ultimately discharged through the slots 45 in the rear 44 of the top cover plate 14.

Returning to a consideration of the air flowing along and between the fins 16 from the bottom discharge port 59 and the louver 42, it has been found that this air flow may tend to dissipate downward and around the fins 15 so as to flow transversely thereof. Such cross flows impair the heat transfer efficiency of the cooling fins 16. Thus, it is preferable to provide means for maintaining the air flow between the fins 16. One approach for achieving this objective is to mount a cover plate on the bottom of the fins 16. An alternate approach, shown in FIG. 1, resides in appropriately sizing the feet 51 which are interposed between the bottom of the machine and surface 50 upon which the machine is mounted. Through the expedient of providing appropriately sized feet, the bottom of the fins 16 may be maintained at an appropriated distance from the mounting surface 50. Experiments conducted upon the occasion of this invention have indicated that the distance between the bottom of the fins 16 and the mounting surface should not be greater than approximately one-eighth of an inch and should preferably be approximately one-sixteenth if the air flow between the fins is to be maintained.

To determine the effectiveness of the invention hereinbefore described, a high speed, industrial sewing machine was constructed and provided with the cooling system described above. When operated at a speed of 8,000 rpm, the overall machine temperature was reduced by approximately **15** percent as compared to a similar machine operating at the same speed but not provided with this type of cooling system. In other experiments, machines adapted with the cooling system described herein and operated at speeds of 8,000 rpm were maintained at the same temperature as similar machines operated at only 7,000 rpm but not provided with the above described cooling system.

It is believed that a number of factors intrinsic in the design of the instant cooling system cooperatively interact to provide the superior heat dissipating effects which have been observed. For example, the use of a ducted fan as opposed to an unducted fan is believed to contribute significantly to the air handling efficiency of the fan. Similarly, because the fan provides a substantially axial flow and because of the louvers associated with the fan, it is believed that energy dissipating vortices are avoided and, as a result, a major portion of the energy expended for rotating the fan is converted into usable air flow.

Still another factor which is believed to be significant resides in providing a construction whereby both the top and bottom of the machine is cooled. In this connection, it is significant to note that the construction of the instant invention functions to insure that a major portion of the air handled by the fan is discharged over and along the bottom of the machine. Thus, as compared to the air which flows over the bottom of the machine, a smaller portion of air handled by the fan flows over the top of the machine. Controlling the two air flows in this manner is believed to be of significance for the following reasons. Considering a sewing machine of the type shown in FIG. **1**, it has hereinbefore been noted that when in operation, the oil reservoir **60** will be at an elevated temperature. Similarly, the environment within the machine chamber **9** will be at an elevated temperature thus heating the top oil cover plate **13.** However, comparing the oil reservoir **60** to the remainder of environment within the machine chamber **9**, it will be appreciated that the oil in the reservoir **60** has a significantly higher specific heat than the air which substantially fills the machine chamber **9.** Thus, to reduce the temperature of the oil **60** by a given amount, more heat will have to be transferred therefrom than would have to be transferred from the air in the machine chamber **9** in order to lower the temperature of the air by the same amount. Thus, by utilizing the instant invention, a higher cooling air flow is provided with respect to the oil reservoir **60** than with respect to the top oil cover plate **13.**

Another feature of the instant invention which would appear to differentiate it in effectiveness from the prior art resides in the fact that the air directed from the fan to the fins is cool air which is heated as the air flows along and between the fins. Thus, in fluid dynamic terms, the air flow between the fins would appear to be Rayleigh line flow which is characterized by a continuous increase in velocity due to heat transferred to the air. As the air flows along and between the fins, it is heated and the air expands. Because of the expansion of the air, the velocity of the flowing air is increased. By confining the air flow within the fins, by the tableboard or a cover, the increase in velocity of the air flow results in a greater dissipation of heat than in prior art systems where the air flow was not confined, by some means, to flowing along the fins. Similarly, prior art systems which directed an air flow perpendicularly or obliquely to heat dissipating fins would not possess the above described attributes of the instant cooling system.

Although there has hereinbefore described, by way of example, a preferred embodiment of the instant invention, it will be appreciated that changes in the specific structure thereof may be made by those skilled in the art to which this invention pertains without, nevertheless, departing from the scope of the invention as defined by the claims appended hereto.

We claim:

1. A sewing machine which comprises:

a. an up-standing frame defining a machine chamber and a second chamber adjacent to said machine chamber at one end of said machine, said second chamber having an inlet port and at least one discharge port;

b. an operating head mounted on said frame at the other end of said machine;

c. a top oil cover plate mounted on the top of said frame and sealing the top of said machine chamber;

d. a bottom cover plate mounted on said frame and sealing the bottom of said machine chamber;

e. a plurality of heat dissipating fins mounted on the bottom of said bottom cover plate and extending longitudinally thereof;

f. a drive shaft mounted on said frame longitudinally thereof, extending through said machine chamber and said second chamber and adapted for external drive;

g. means within said machine chamber for operatively connecting said drive shaft to said operating head;

h. a ducted fan mounted within said second chamber and on said drive shaft for rotation therewith; and

i. means for directing air discharged from said fan along said fins.

2. The sewing machine of claim **1** wherein said heat dissipating fins are an integral part of said bottom cover plate.

3. The sewing machine of claim **2** which further includes means for directing air discharged from said fan over said top oil cover plate.

4. The sewing machine of claim **3** which further comprises air flow maintaining means for maintaining the air flow between said fins.

5. The sewing machine of claim **4** wherein said means for directing air over said top oil cover plate includes means for restricting the air flow over said top oil cover plate such that less air flows over said top oil cover plate than along said fins.

6. The sewing machine of claim **5** wherein said air flow maintaining means is a plate mounted on the bottom of said fins.

7. The sewing machine of claim **5** wherein said air flow maintaining means comprises mounting means for maintaining the bottom of said fins adjacent to the surface on which said machine is mounted.

8. The sewing machine of claim **5** wherein said means for directing air oversaid top oil cover plate includes a top cover plate mounted on said frame above said top oil cover plate, defining a channel therebetween which is in fluid communication with said second chamber, said top plate including at least one air discharge slot.

9. A sewing machine which comprises:

a. an up-standing frame defining a machine chamber and a second chamber adjacent to said machine chamber at one end of said machine, said second chamber having an inlet port, a bottom discharge port and a top discharge port;

b. an operating head mounted on said frame at the other end of said machine;

c. a top oil cover plate mounted on the top of said frame and sealing the top of said machine chamber;

d. a top cover plate, having at least one air discharge slot, mounted on said frame over said top oil cover plate forming a sealed chamber with said top oil cover plate, said sealed chamber being in fluid communciation with said top discharge port;

e. a bottom cover plate mounted on said frame and sealing the bottom of said machine chamber;

f. a plurality of heat dissipating fins mounted on the bottom of said bottom cover plate and extending longitudinally thereof;

g. a drive shaft mounted on said frame longitudinally thereof, extending through said machine chamber and said second chamber and adapted for external drive;

h. means within said machine chamber for operatively connecting said drive shaft to said operating head;

i. a ducted fan mounted within said second chamber and on said drive shaft for rotation therewith;

j. means for directing air from said ducted fan,

i. through said top port, and

ii. through said bottom port and along said fins.

10. The sewing machine of claim **9** wherein said means for discharging air from said fan through said top port comprises a fan duct having a slot in the top portion thereof adjacent said top discharge port.

11. The sewing machine of claim **10** wherein said means for directing air from said fan along said fins comprises:

a. a plurality of downwardly facing louvers mounted on said duct adjacent to the axial discharge of said fan; and

b. a horizontally disposed louver mounted on said frame adjacent to the bottom discharge port.

12. The sewing machine of claim **11** wherein said heat dissipating fins are an integral part of said bottom cover plate.

13. The sewing machine of claim **12** which further comprises air flow maintaining means for maintaining the air flow between said fins.

14. The sewing machine of claim **13** wherein said air flow maintaining means is a plate mounted on the bottom of said fins.

15. The sewing machine of claim **13** wherein said air flow maintaining means comprises mounting means for maintaining the bottom of said fins adjacent to the surface on which said machine is mounted.

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