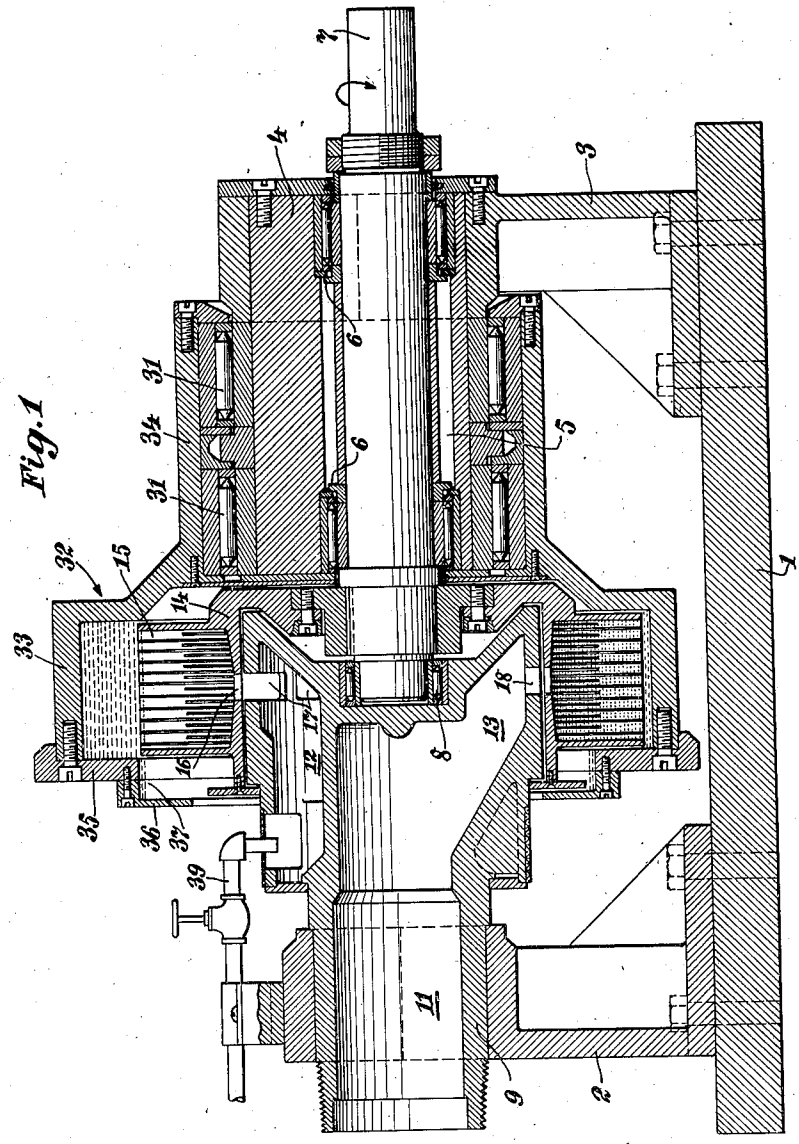
Nov. 9, 1948. P. KOLLSMAN 2,453,374

COMPRESSOR

Filed Aug. 28, 1944 2 Sheets-Sheet 1

Fig. 1



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COMPRESSOR

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Fig. 3

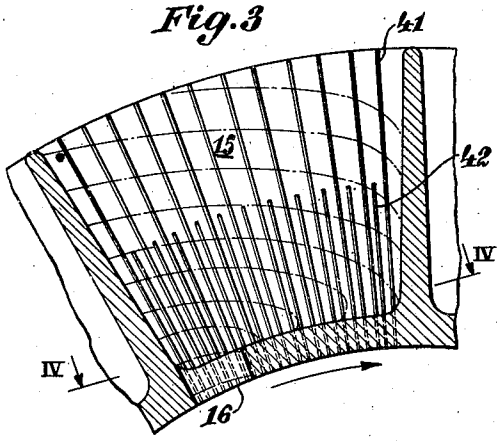


Fig. 2

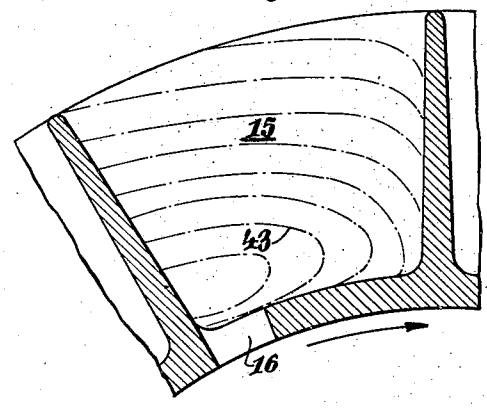


Fig. 4

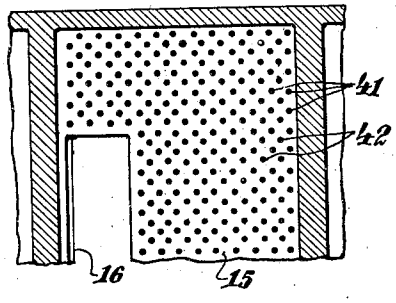


Fig. 5

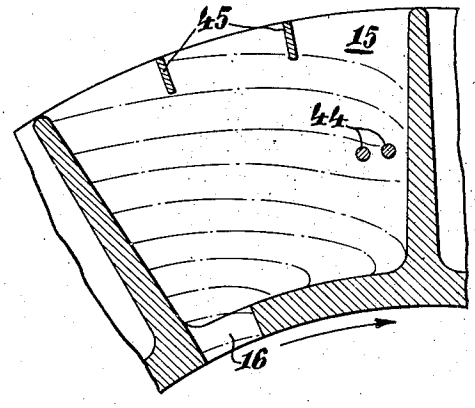


Fig. 7

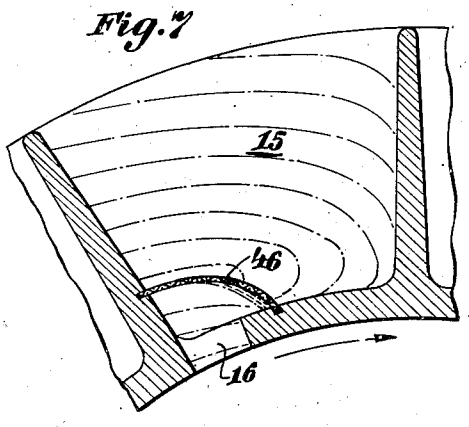
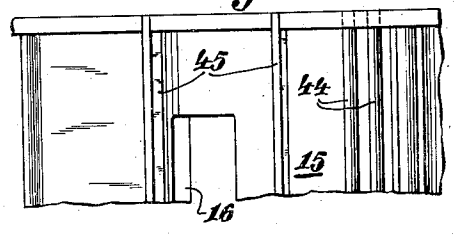


Fig. 6



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UNITED STATES PATENT OFFICE

2,453,374

COMPRESSOR

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Application August 28, 1944, Serial No. 551,510

17 Claims. (Cl. 230—79)

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This invention relates to rotary, liquid piston machines, and more particularly to rotary compressors using liquid as the compressing medium.

The structural features of the machine herein disclosed, other than the arrangement of the compression chamber and the elements therein, are described and claimed in my co-pending application Serial No. 551,509, entitled Compressor, filed August 28, 1944.

One object of the invention is to provide in a rotary compressor or other machine using liquid as the compressing medium means for controlling the flow of liquid into the compression chamber so as to prevent the trapping of gas pockets by the compressing liquid and to insure the complete evacuation of the compressed gas from the chamber.

Another object of the invention is to provide a rotary compressor or other machine using liquid as the compressing medium with means providing for improved transfer of heat from the compressed gases so as to lower the temperature increase due to the compressing operation.

Other objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

Figure 1 is a longitudinal vertical sectional view through a compressor according to the present invention.

Figure 2 is a detailed sectional view showing a compression chamber and the movement of the compressing liquid thereinto without the modifying means of the present invention.

Figure 3 is a detailed sectional view of the compression chamber showing one form of the invention.

Figure 4 is a partial plane view of the compression chamber of Figure 3.

Figure 5 is a detailed sectional view of a modified form of compression chamber according to the invention.

Figure 6 is a partial top plan view of the compression chamber of Figure 5.

Figure 7 is a detailed sectional view of a compression chamber according to a further modification of the invention.

The compressor as specifically illustrated comprises a bed plate 1 upon which are mounted supports 2 and 3. Within the support 3 is mounted the bearing support 4 having an exterior cylindrical surface and an interior cylindrical bore 5 on an eccentric axis. Within the bore 5 on the roller bearing indicated at 6 is rotatably supported a drive shaft 7. The interior end of the shaft 7 is also rotatably connected by a roller bearing 8 to a stationary structure 9 mounted in the support 2 and containing the compressor outlet 11 and intake and outlet chambers 12 and 13. This connection properly aligns the chamber and rotor surfaces. On the shaft 7 is mounted a rotor 14 having a cylindrical periphery in which are formed a plurality of relatively large pockets or compression chambers 15. Each of the chambers 15 has in its base an opening 16 which cooperates with the inlet ports 17 in the wall of the inlet chamber 12 and with the outlet ports 18 in the wall of the outlet chamber 13 for the intake and delivery of the air or other gas to be compressed.

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On the exterior of the bearing support 4 by means of roller bearings 31 is mounted an exterior rotor 32 on an axis eccentric with the axis of the shaft 7 and with the interior surface of the rotor 32 having only mechanical clearance from the periphery of the rotor 14 at their nearest surfaces. The rotor 32 has a cup portion 33 about the chambers 15 and an integral elongated cylindrical portion 34 carrying the seats of the bearings 31. The cup portion 33 of the rotor 32 is closed by an end plate 35. On the plate 35 is mounted an annulus 36 forming a well or trap 37 within which any compressor liquid which escapes from the cup 33 will be caught by centrifugal force and returned. A liquid source indicated at 39 is provided to replace the water or other compressor liquid lost in the operation of the machine.

The compressor is illustrated in Figure 1 under operating conditions in which the water or other operating liquid is maintained in the position shown by centrifugal force. As the rotor 7 is driven, the idler rotor 32 will rotate therewith with only negligible slip. The compressing liquid will alternately enter and leave the chambers 15 depending upon the chamber position with respect to the eccentricity of the rollers. In this movement of the compressing liquid it functions as a piston in drawing in and compressing and expelling the gas.

Figures 1, 3 and 4 illustrate the preferred embodiment of the compression chamber according to applicant's invention. In the chamber are disposed a large number of fine but relatively rigid wires or rods 41 extending radially from the base of the chamber and adjacent to the chamber base are disposed a number of similar but shorter wires or rods 42. The function of the wires or rods 41 and 42 is two-fold. First, to control the shape of

the surface of the entering liquid and secondly, to provide for the absorption of heat from the compressed gases so that an approach toward isothermal compression is made. From the standpoint of heat transfer, it is desirable to have as many pins or rods as possible and therefore a maximum surface area for heat transfer. However, the more surface area engaged by the liquid the less is the efficiency due to the frictional losses. Hence, the number selected will be determined by the relative desirability or undesirability of these two factors. Furthermore, the density of the gas is less adjacent the periphery of the chamber and also the volume of liquid to be moved past this point is greater than adjacent the base of the pocket; accordingly, it is desired to use a larger number of the pins or rods adjacent the base because of the increased density of the gas from which heat is to be absorbed and the lessened water stroke which reduces frictional losses. While only two stages have been shown in Figures 1 and 3, it will, of course, be understood that the greater the number of stages or even a continuously increasing number of pins or rods is theoretically the most desirable construction.

The second function of the pins or rods **41** and **42** will be explained after a discussion of the open chamber of Figure 2. The opening **16** is disposed at the trailing wall of the compression chamber as this is the optimum position for the expelling of the compressed gas, but if the chamber is large and unobstructed, the entering liquid, progressively assuming the levels shown by the broken lines in Figure 2, will seal off the outlet opening while trapping a part of the gas within the chamber with consequent lowering in delivery and efficiency of the compressor. It is believed that this movement of the liquid occurs because as it is moved to a smaller radius it will have a higher velocity than the chamber at that radius and will accordingly tend to build up on the leading wall of the compression chamber. As indicated in Figure 2, when the entering liquid reaches the position shown by the broken line **43**, it will have sealed off the outlet opening **16** and will have trapped within the compression chamber the gas remaining between this liquid level and the trailing wall of the chamber. Thereafter any further compressor action will result only in spilling over of the compressing liquid while the pocket of gas is trapped within the chamber.

The pins or rods **41** and **42** while they have little resistance to longitudinal movement of the liquid will have a relatively large resistance to the transverse movement thereof and will smooth out the advancing wave form of the entering liquid into the levels indicated by the broken lines of Figure 3 wherein it is seen that the liquid level approaches the outlet opening **16** relatively symmetrically and reaches the outlet only after all of the gas within the chamber has been evacuated through the outlet opening.

In the modification of the invention illustrated in Figure 5, a similar control of the advancing wave form of the entering liquid is obtained by the use of the transverse rods **44** disposed adjacent the leading wall of the compression chamber where they resist the normal movement of the higher speed liquid and slow up its movement inwardly of the leading wall. The resulting advancing wave form of the entering liquid is shown in the broken line construction wherein it is seen that again the liquid reaches the outlet opening only after the compressed gas has been entirely expelled from the chamber. The transverse ribs **45** are provided to secure a better grip upon the compressing liquid and insure its rotation with the inner rotor without undesirable slip.

Figure 7 shows a further modification of the invention in which there is provided in the compression chamber, adjacent the outlet **16**, a screen or similar obstruction **46** offering a relatively high resistance to the passage of the liquid therethrough. In this modification the liquid entering the compression chamber will have substantially the same wave form as the entering liquid of Figure 2 until it reaches the screen **46**. The liquid advancing along the chamber base toward the outlet opening will be slowed up in its movement to permit the more rapid relative movement of the liquid along the trailing wall of the chamber so that again the liquid enters the outlet opening only after the compressed gas has been expelled and the trapping of a gas pocket within the chamber is avoided. Since the screen **46** is located close to the outlet opening **16** only a small volume of liquid passes therethrough and the frictional loss is low.

While the invention has been specifically illustrated in connection with a gas compressor, it will, of course, be obvious that various features thereof are applicable to engines and other forms of liquid piston machinery and, while certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, a discharge opening for each of said chambers in the base thereof adjacent to the trailing wall, and means for impeding the travel of the compressing liquid adjacent to the leading wall only of the chamber to provide for the expelling of all of the gas from the chamber before the compressing liquid seals the discharge opening.

2. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and a plurality of radially extending elements within said chambers presenting surfaces for the absorption of heat from the gas therein, the area of said surfaces varying radially of said chamber and being greatest adjacent the outlet opening where the gas density is greatest and the liquid travel least.

3. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said

portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and a plurality of radially extending rods disposed within said chambers.

4. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, an opening in a wall of each of said chambers through which gas is discharged, and a plurality of radially extending rods disposed within said chambers, said rods affording surfaces for absorption of heat from the compressed gages and preventing relatively slight resistance to the radial flow of the compressing liquid.

5. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, an opening in a wall of each of said chambers through which gas is discharged, and a plurality of radially extending rods disposed within said chambers, said rods affording surfaces for absorption of heat from the compressed gases and presenting relatively slight resistance to the radial flow of the compressing liquid but presenting substantial resistance to the transverse flow of the liquid to equalize its approach to the discharge opening.

6. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, gas discharge openings in the bases of said chambers and remote from the leading walls thereof, and means disposed adjacent the leading walls only of the chambers to impede the flow of compressing liquid thereat to equalize the approach of the liquid to the passage openings.

7. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, gas discharge openings in the bases of said chambers remote from the leading walls thereof, and transverse elements located in said chamber adjacent to the leading wall only thereof and serving to impede the travel of the compressing liquid thereat.

8. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, openings in the bases of said chambers through which gas is discharged, and baffling means disposed immediately adjacent to said discharge openings and offering an appreciable resistance to the flow of the compressing liquid therethrough toward the openings whereby to substantially equalize the approach of the liquid to the opening.

9. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, openings in the bases of said chambers through which gas is discharged, and screens covering the approaches to said discharge openings at a short distance therefrom and offering sufficient resistance to the flow of the compressing liquid therethrough to substantially equalize the approach of the liquid to the openings.

10. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and means immediately adjacent to at least certain of the walls of said chambers permitting circumferential movement of the compressing liquid thereby while impeding such movement to slow up the more rapidly moving portions of the liquid to prevent sealing off of gas pockets within the chambers.

11. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, discharge openings in said chambers, and means immediately adjacent to walls in said chambers on the leading sides of said discharge openings permitting circumferential movement of the compressing liquid thereby while impeding such movement to slow up the more rapidly moving portions of the liquid to prevent sealing off of gas pockets within the chambers.

12. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, discharge openings in said chambers, means immediately adjacent to walls of said chambers on the leading sides of said discharge openings per-

mitting circumferential movement of the compressing liquid thereby while impeding such movement to slow up the more rapidly moving portion of the liquid, said last mentioned means extending for at least the projected length of the discharge opening to impede the circumferential approach of compressing liquid thereto.

13. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and means at least adjacent to the bottoms of said chambers permitting circumferential movement of the compressing liquid thereby while impeding such movement to slow up the more rapidly moving portions of the liquid to prevent sealing off of the gas pockets within the chambers.

14. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, discharge openings in said chambers, and means adjacent to the bottoms of said chambers on the leading side of said discharge openings permitting circumferential movement of the compressing liquid thereby while impeding such movement to slow up the more rapidly moving portions of the liquid to prevent sealing off of gas pockets within the chambers.

15. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and elements in said chambers permitting circumferential movement of the compressing liquid thereby substantially throughout their length while impeding such movement to slow up the more rapidly moving portions of the liquid to

prevent sealing off of gas pockets within the chambers.

16. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, and rod like elements extending radially of said chambers and permitting circumferential movement of the compressing liquid while impeding such movement to slow up the more rapidly moving portions of the liquid to prevent sealing off of gas pockets within the chambers.

17. In a rotary, liquid piston machine, an exterior rotor having an annular portion for the reception of a compressing liquid, a compressing liquid in said portion, an interior rotor in said portion mounted on an axis eccentric to the axis of said exterior rotor and having a plurality of open chambers about the periphery thereof, gas inlet and outlet ports for said chambers, means for driving said rotors to effect rotation thereof, an opening in the base of each of said chambers through which gas is discharged, and a plurality of radially extending rods of different lengths within said chambers, said rods affording surfaces for the absorption of heat from the compressed gases and presenting relatively slightly resistance to the radial flow of compressing liquid but presenting substantial resistance to the transverse flow of the liquid to equalize its approach to the discharge openings, the different lengths of the rods increasing the heat transfer surfaces adjacent the discharge openings where the gas density is greatest.

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