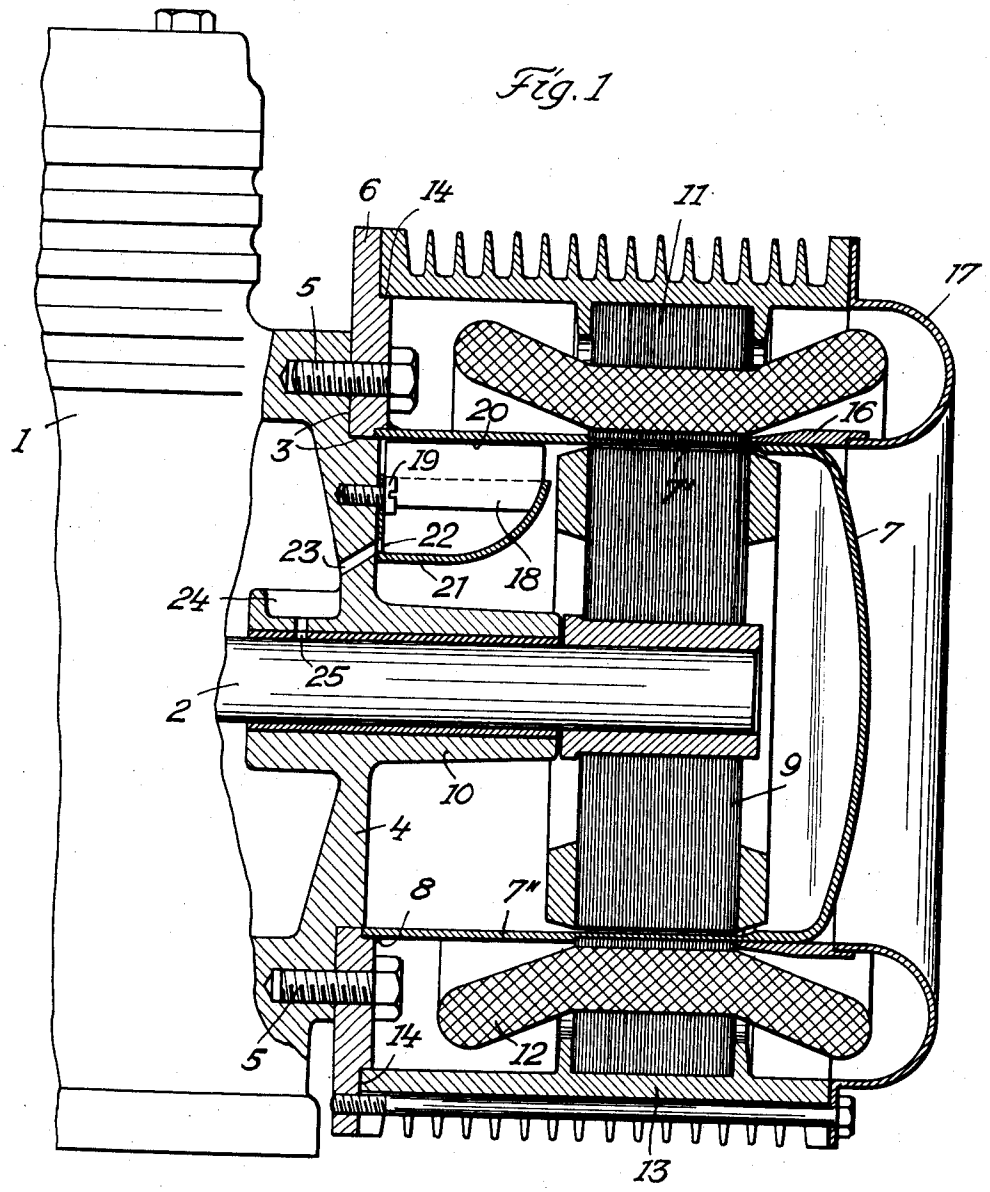
Nov. 3, 1959 R. CULK 2,911,549

ELECTRIC-MOTOR DRIVE FOR A COMPRESSOR HAVING A HORIZONTAL DRIVE SHAFT

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Fig. 1



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Fig. 2

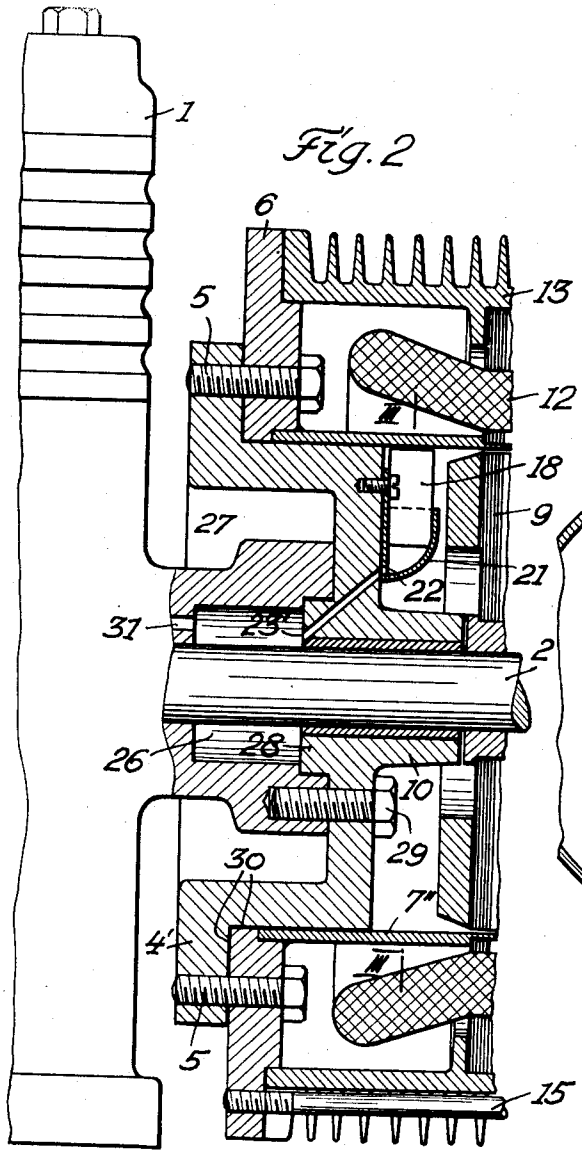
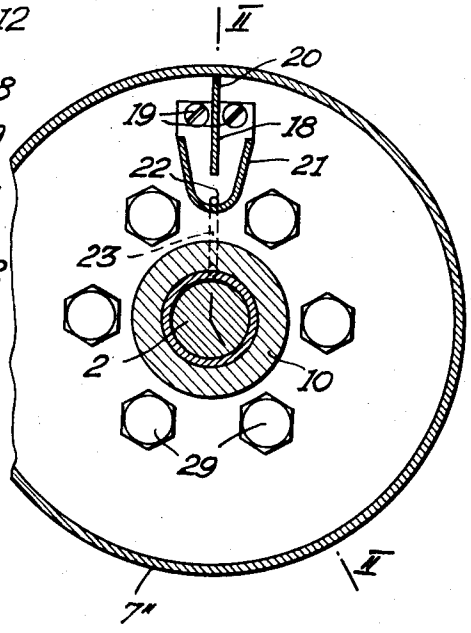


Fig. 3



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ELECTRIC-MOTOR DRIVE FOR A COMPRESSOR HAVING A HORIZONTAL DRIVE SHAFT

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Claims priority, application Austria July 7, 1956

6 Claims. (Cl. 310—86)

Compressors for refrigeration, with an electric drive motor, have already been proposed, in which the rotor is surrounded by a hood, which consists of magnetically non-conducting material of high electric resistance and surrounds the rotor with an extremely small clearance and is gastightly mounted on the plate which supports the stator. This arrangement eliminates the need for providing a stuffing-box at the point where the horizontally arranged drive shaft extends through the compressor housing. Such drives have not proved satisfactory in operation because the centre of gravity of the relatively long and heavy rotor, which is carried on the shaft in an overhung arrangement, is relatively widely spaced from the bearing so that it will perform rotary oscillations about the horizontal drive shaft in operation and the air gap provided between rotor and hood must be relatively wide to avoid chafing of the rotating rotor on the hood. This will reduce the efficiency of such drives so that the motor must have a much higher rating for a given driving power desired. This involves a higher weight of the stator and a stronger and thicker design of the base plate which holds the stator and connects it to the compressor housing. For this reason that base plate is profiled in known drives. As a result, the stator is overhung to a considerable extent and loads the hood. Moreover, the inside surface of the shell of the hood is not machined jointly with the centering extension of the base plate so that the centric running of the rotor is not ensured and the later is liable to chafe on the hood after a relatively short period of operation. In addition, the integral hood is very expensive and can be machined only with difficulty owing to its excessive length.

It may also be mentioned that it has already been proposed in connection with enclosed motor-driven compressors for refrigerating machines to provide a bucket disc which rotates with the rotor and is immersed in the oil collecting chamber disposed laterally of the stator and which throws the oil from there against the upper wall of the motor housing, from where the oil passes by way of a guide surface and bores in the partition between the motor housing and compressor housing into a collecting container and is used for lubricating the bearing of the motor shaft.

This invention relates to an electric-motor drive for a compressor for refrigeration having a horizontal drive shaft, the rotor of which motor is carried in an overhung arrangement on the horizontal compressor shaft and is separated from the stator by a hood, the stator and the hood being centrally affixed to the housing of the compressor by means of a carrying ring and the shell of the hood being reduced in thickness adjacent to the stator. It is an object of the invention to avoid the aforesaid disadvantages of the known arrangements, to improve the efficiency of such drives and to feed the lubricant which enters the hood together with the refrigerant back into the compressor housing. The invention resides essentially in that the carrying ring for fixing and centering

the hood and the stator is disc-shaped and its inner end face carried on an annular step of the end wall of the housing concentrically carries the thicker shell portion of the hood, and that the height of the reduced shell portion of the hood as well as the height of the rotor is approximately one third of the diameter of the rotor and the thicker shell portion corresponds substantially to the length of the bearing for the drive shaft, which bearing extends into the hood, the hood being preferably of bipartite construction and the thicker shell portion consisting, e.g., of boiler tubing whereas the reduced shell portion consists in a manner known per se of nickel-chromium steel. With this construction the clearance between the hood and rotor can be made extremely small, providing for a high efficiency of the drive and achieving almost the output of hoodless motors. Because the centre of gravity of the stator is close to the end wall of the housing the hood is not loaded by the weight of the stator but is even held by the latter in its cylindrical shape. Since the thicker hood portion is manufactured from a boiler tubing the hood is very inexpensive in prime cost and manufacture, with the additional advantage that the short and rigid hood enables a very exact machining of the inside peripheral surface of the hood. The stator housing constructed as a cooling jacket is affixed jointly with a spring ring to the carrying ring by screws and the spring ring carries on its inner rim a supporting ring, which embraces the hood and which compresses the laminated stator core, carried by the stator housing, at its rim surrounding the hood. The invention relates further to developments in construction to enable the lubricant which has entered the hood with the refrigerant to be fed back into the compressor housing, and the conversion of open reciprocating compressors into enclosed arrangements.

Two illustrative embodiments of the invention are shown in the accompanying drawing in Figs. 1 and 2 in vertical sectional views, respectively, whereas Fig. 3 shows a detail.

A plunger-type compressor **1** of the usual construction has an end wall **4**, which is provided with a concentric annular step **3** and through which the drive shaft **2** extends into the compressor. This end wall is formed at its periphery with uniformly spaced bores for the passage of fixing screws **5** for a carrying ring **6** for a hood **7**. The carrying ring **6** and the hood **7**, which consists of magnetically non-conductive material of high electric resistance, are gastightly connected to each other at **8** by welding or soldering and are then jointly machined so that the cylindrical peripheral surface of the hood **7** is exactly concentric with the annular step **3** and the drive shaft **2**. The shell of the hood **7** is of reduced thickness adjacent to the electromagnetic field, in known manner. The reduced portion **7'** of the shell corresponds approximately to the height of the rotor **9**, which is disc-shaped in the present case and is affixed to the drive shaft **2**. The height of the rotor **9** is approximately one third its diameter. The peripheral surface of the hood **7** is exactly concentric with the rotor **9** affixed to the drive shaft **2** so that the annular clearance between the rotor **9** and the hood **7** may be very small. The thicker shell portion **7''** which adjoins the reduced shell portion **7'** and is connected to the carrying ring **6** corresponds to the length of the bearing **10** for the drive shaft **2**, which bearing is carried by the end wall **4** and extends into the hood. Thus, the centre of gravity of the rotor **9** is very close to the bearing **10** for the drive shaft and owing to its narrow construction the rotor acts as a flywheel to ensure a smooth running without vibration; disturbances as are liable to occur in known drives are avoided in spite of the small clearance between the rotor **9** and the

shell portion 7'. The stator 11 with its winding 12 is passed onto the hood 7 as far as to the annular step between the parts 7' and 7'' and is surrounded by a housing 13, which is constructed as a cooling jacket and fixed by means of screws 15 in an annular step 14 of the carrying ring 6. Close to its closed end the hood 7 is embraced by a supporting ring 16, which is carried on a spring ring 17, which is held down on the carrying ring 6 together with the housing 13 by the screws 15. The spring ring 17 urges the supporting ring 16 with its front annular face against the inside rim of the laminated stator core 11 to stress the same so that the laminations of the core are clamped between the annular step between parts 7' and 7'', on the one hand, and the supporting ring 16. A scraper plate 18 extends at right angles from the end wall 4 and is affixed thereto by means of screws 19. The upper edge 20 of said plate extends almost to the periphery of the hood 7 whereas the lower end of the plate is embraced by a bowl 21 extending on both sides beyond the plate. This bowl is formed at its lowermost point with a hole 22, which registers with a bore 23 formed in the end wall 4 and opening into the compressor housing. A collecting pan 24 is provided on the end wall 4 below the opening of the bore 23 in the compressor housing and a bore 25 extends from said pan to the bearing surface of the drive shaft 2 to ensure the lubrication of the bearing. The oil collecting at the bottom of the hood will adhere to the rotor 9 which is immersed in the oil and which will carry the oil along during rotation to distribute the oil evenly over the periphery of the hood 7. As the rotor passes the plate 18 the oil is contacted and scraped off by the edge of the plate. The oil collects in the bowl 21 and flows through the bore 23 into the collecting pan 24 and from there into the bearing and may also flow back into the compressor housing.

The construction according to the invention enables the closed end of the hood 7 to be kept free, whereby an improved cooling of the motor can be achieved. The clamping down of the stator 11 and the winding 12 on the carrying ring 6 by means of the screws 15 causes the weight of the stator to be applied directly to the carrying ring 6, the hood 7 being perfectly relieved.

The embodiment shown in Fig. 2 corresponds to that of Fig. 1 in respect of the construction of the rotor 9 and of the stator 11—13 as well as of the hood 7 and for this reason has not been shown in more detail. It shows how an open plunger-type compressor can be converted into an enclosed compressor. The drive shaft 2 extends through the cavity 26 of the hublike extension 27 of the compressor housing and a flange 4', which has an accurately concentric extension 28 exactly fitting in the cavity 26 and seals the same by gastightly engaging the end face of the extension 27. Whereas the cavity 26 accommodates usually the slip ring shaft seal the latter can be eliminated because the cavity is sealed towards the outside of the flange 4' gastightly engaging the end face of the extension 27. The flange 4' is fixed by screws 29 and has an annular step 30, which is exactly concentric with the extension 28 and on which the carrying ring 6 for the hood 7 can be gastightly mounted and clamped by screws 5 like in the first embodiment. The scraper plate 18 affixed to the flange 4' and the bowl 21 extending beyond the lower edge of said plate are of the same construction but the bore 23' extending from the hole 22 opens into the cavity 26 of the hublike extension 27, which is connected to the interior of the compressor housing by a bore 31 so that the oil which is evenly distributed over the periphery of the hood in operation is scraped off by the plate 18 to flow into the bowl 21 and from there through the cavity back into the compressor housing.

The construction described enables a quick and inexpensive conversion of commercial open reciprocating compressors for refrigeration into closed units without particularly great additional expense.

I claim:

1. An electric-motor drive for a compressor for refrigeration comprising a horizontal drive shaft, said drive comprising a generally vertical wall formed with an opening adapted to receive said shaft, and with an annular step surrounding said opening, a disc-shaped carrying ring affixed to said wall and having an inside peripheral surface engaging said step, a rotor adapted to be carried by said shaft in an overhung arrangement and having an axial length which is of the order of one third of its diameter, a stator concentrically surrounding said rotor and affixed to said carrying ring, a hood having a shell concentrically interposed between said rotor and stator and a closed end remote from said wall, a bearing carried by said wall and having a portion extending into said hood, said bearing being adapted to carry said shaft, said shell having a reduced portion of relatively small wall thickness which has substantially the axial length of the rotor and surrounds the same, and a thicker portion of relatively great wall thickness which has substantially the axial length of said bearing portion extending into the hood and surrounds said portion, said thicker shell portion being affixed to said inside peripheral surface of said carrying ring, said stator comprising a stator housing constructed as a cooling jacket and a laminated stator core carried by said stator housing, and which comprises a spring ring, screws connecting said stator housing jointly with said spring ring to said carrying ring, and a supporting ring carried by the inner rim of said spring ring and having a free rim embracing the hood, said shell being formed with a peripheral annular step between said thicker and reduced portions and said stator core being compressed between said free rim of said supporting ring and said peripheral step of said shell.

2. An electric-motor drive for a compressor for refrigeration comprising a horizontal drive shaft, said drive comprising a generally vertical wall formed with an opening adapted to receive said shaft, and with an annular step surrounding said opening, a disc-shaped carrying ring affixed to said wall and having an inside peripheral surface engaging said step, a rotor adapted to be carried by said shaft in an overhung arrangement and having an axial length which is of the order of one third of its diameter, a stator concentrically surrounding said rotor and affixed to said carrying ring, a hood having a shell concentrically interposed between said rotor and stator and a closed end remote from said wall, a bearing carried by said wall and having a portion extending into said hood, said bearing being adapted to carry said shaft, said shell having a reduced portion of relatively small wall thickness which has substantially the axial length of the rotor and surrounds the same, and a thicker portion of relatively great wall thickness which has substantially the axial length of said bearing portion extending into the hood and surrounds said portion, said thicker shell portion being affixed to said inside peripheral surface of said carrying ring, said drive further comprising a scraper plate carried by said wall and extending upwardly almost to the inside peripheral surface of said thicker portion of the shell of said hood, a bowl carried by said end wall and embracing the lower end of said scraper plate and formed at its lowermost point with a hole, and a duct extending through said wall and connected to said hole.

3. The drive as set forth in claim 2, which comprises a collecting pan carried by said wall on the side opposite to said bowl and arranged to receive oil from said duct, said bearing having a portion extending on the same side of said wall as said pan and arranged to receive oil from said pan.

4. An electric-motor drive for a compressor for refrigeration comprising a horizontal drive shaft, said drive

comprising a generally vertical wall formed with an opening adapted to receive said shaft, and with an annular step surrounding said opening, a disc-shaped carrying ring affixed to said wall and having an inside peripheral surface engaging said step, a rotor adapted to be carried by said shaft in an overhung arrangement and having an axial length which is of the order of one third of its diameter, a stator concentrically surrounding said rotor and affixed to said carrying ring, a hood having a shell concentrically interposed between said rotor and stator and a closed end remote from said wall, a bearing carried by said wall and having a portion extending into said hood, said bearing being adapted to carry said shaft, said shell having a reduced portion of relatively small wall thickness which has substantially the axial length of the rotor and surrounds the same, and a thicker portion of relatively great wall thickness which has substantially the axial length of said bearing portion extending into the hood and surrounds said portion, said thicker shell portion being affixed to said inside peripheral surface of said carrying ring, said drive further comprising a cylindrical hub extension adapted to surround said shaft and having a free end face gas-tightly secured to said wall, and a cylindrical flange extension carried by said wall and extending into said hub extension.

5. The drive as set forth in claim 4, which comprises a scraper plate carried by said wall and extending upwardly almost to the inside peripheral surface of said thicker portion of the shell of said hood, a bowl carried by said wall and embracing the lower end of said scraper plate and formed at its lowermost point with a hole, a duct extending through said wall and connected to said hole, said duct leading into the interior of said hub extension.

6. The drive as set forth in claim 5, which comprises a compressor housing end wall portion closing said hub extension at the end opposite to said free end, said end wall portion being formed with a through bore providing communication between the interior of said hub extension and the interior of said compressor.

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