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(54) **SCREW COMPRESSOR, REFRIGERATION SYSTEM**

(57) A screw compressor (1), comprising: a compressor housing (101) provided with a compression chamber inside; an economizer (202) communicating with the compressor housing (101) through an economizer pipeline (103); and a first muffler reaction chamber (102) disposed in the compressor housing (101) and having an economizer compression chamber port (1021) communicating with the compression chamber, wherein the economizer pipeline (103) has one end communicating with the first muffler reaction chamber (102) and the other end communicating with the economizer (202), and the screw compressor (1) further comprises a second muffler reaction chamber (104) communicating with the economizer pipeline (103), and surrounding and protruding from an outer wall of the economizer pipeline (103).

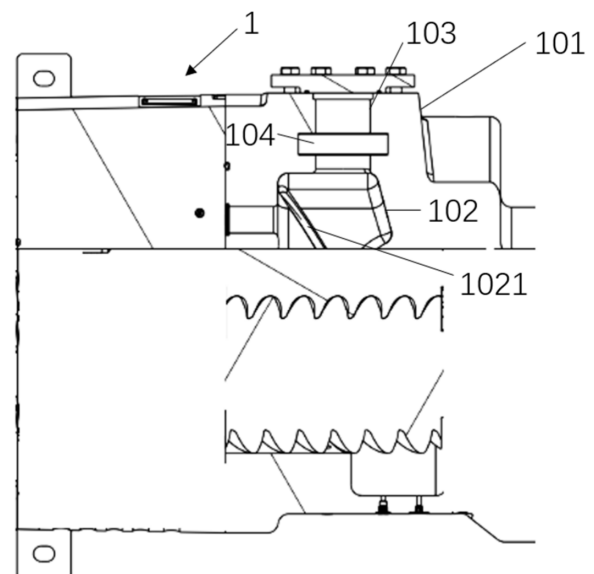


Fig. 2

Description

PRIORITY CLAIM

[0001] This application claims benefit of Chinese Patent Application No. 202411611846.9, filed November 12, 2024, and all the benefits accruing therefrom under 35 U.S.C. §119, the contents of which in their entirety are herein incorporated by reference.

BACKGROUND

[0002] This application relates to the technical field of refrigeration/cooling equipment, and in particular to a screw compressor and a refrigeration system including the screw compressor.

[0003] A screw compressor usually uses an economizer to improve a capacity and COP of an air conditioning group, but pulsation propagation from an economizer port always affects an operation of the screw compressor and induces pipeline vibration to generate noise. In the related art, at an economizer port where an economizer pipeline is connected to a compression chamber, a muffling chamber is usually provided to reduce pressure pulsation transmitted to the economizer pipeline and downstream of the economizer pipeline. In the design, a compressor speed is considered in combination with compressor structural parameters, and a chamber is designed for a predicted main frequency band where a compressor is operated.

[0004] When such a compressor is applied to a high-temperature and high-pressure design of a heat pump or the like, pressure pulsation may be enhanced to some extent, and a chamber generally needs to be designed to have better muffling performance, such as higher pressure pulsation transmission loss and a wider effective action frequency range.

[0005] Therefore, how to effectively reduce pressure pulsation from an economizer pipeline without a large change in design is a problem to be solved.

SUMMARY

[0006] An object of this application is to provide a screw compressor to at least solve or alleviate some problems in the related art.

[0007] Viewed from a first aspect, there is provided a screw compressor including: a compressor housing provided with a compression chamber inside; an economizer communicating with the compressor housing through an economizer pipeline; and a first muffler reaction chamber disposed in the compressor housing and having an economizer compression chamber port communicating with the compression chamber, in which the economizer pipeline has one end communicating with the first muffler reaction chamber and the other end communicating with the economizer, and the screw compressor further includes a second muffler reaction chamber communicat-

ing with the economizer pipeline, and surrounding and protruding from an outer wall of the economizer pipeline.

[0008] A diameter D2 of the second muffler reaction chamber may be at least larger than a pipeline diameter D1 of a communication portion between the economizer pipeline and the first muffler reaction chamber.

[0009] A distance d between the second muffler reaction chamber and the first muffler reaction chamber may be equal to or greater than 10 mm.

[0010] A height H of the second muffler reaction chamber in a radial direction of the economizer pipeline may satisfy a formula condition of $H - D1 \geq 5 \text{ mm}$.

[0011] A length L of the second muffler reaction chamber in an extension direction of the economizer pipeline may satisfy a formula condition of $L \geq 10 \text{ mm}$.

[0012] The screw compressor may further include an orifice plate disposed at a communication portion between the second muffler reaction chamber and the economizer pipeline.

[0013] The screw compressor may further include a sound absorbing material with which the second muffler reaction chamber is filled.

[0014] Viewed from a second aspect, there is provided a refrigeration system including the screw compressor according to the first aspect.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0015]

Fig. 1 is a schematic diagram of a structure of a refrigeration system including a screw compressor according to one or more embodiments of this application.

Fig. 2 is a schematic diagram of a partial structure of the screw compressor according to one or more embodiments of this application.

Fig. 3 is a partially enlarged schematic diagram of the screw compressor according to the embodiment of this application.

Fig. 4 is a curve comparison diagram of a transmission loss calculated when a muffling chamber is designed in the screw compressor according to one or more embodiments of this application and a transmission loss calculated when only a first muffler reaction chamber in the related art is used.

Fig. 5 is a schematic diagram of an economizer pipeline according to a second embodiment of this application.

Fig. 6 is a schematic diagram of an economizer pipeline according to a third embodiment of this application.

Fig. 7 is a schematic diagram of a specific structure of an orifice plate used in the economizer pipeline according to the third embodiment of this application.

Fig. 8 is a schematic diagram of an economizer pipeline according to a fourth embodiment of this

application.

[0016] Reference numerals: screw compressor 1, compressor housing 101, first muffler reaction chamber 102, economizer compression chamber port 1021, economizer pipeline 103, second muffler reaction chamber 104, refrigeration system 2, condenser 201, economizer 202, economizer primary side 2021, economizer primary side outlet 2022, economizer secondary side 2023, first expansion valve 203, second expansion valve 204, evaporator 205, orifice plate 1041, sound absorbing material 1042.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0017] It should be noted that working principles, features, advantages, and the like of a screw compressor according to this application will be explained below by way of embodiments. However, it should be understood that all descriptions are only given for exemplification and therefore these embodiments should not be understood as forming any limitation on this application.

[0018] In addition, for any single technical feature described or implicit in some embodiments mentioned herein, or any single technical feature shown or implicit in the drawings, this application still allows any combination or deletion between these technical features (or their equivalents) without any technical obstacles, thereby obtaining more other embodiments of this application that may not be directly mentioned herein.

[0019] Fig. 1 is a schematic diagram of a structure of a refrigeration system 2 including a screw compressor 1 according to one or more embodiments of this application. As shown in Fig. 1, a refrigerant is compressed into a high-temperature and high-pressure refrigerant gas in the screw compressor 1, and then the high-temperature and high-pressure refrigerant gas is conveyed to a condenser 201 through a refrigerant pipeline, exchanges heat with an external medium such as water or air in the condenser 201, and is reduced in temperature and condensed to a medium-temperature and high-pressure refrigerant gas-liquid mixture or refrigerant liquid, and then the medium-temperature and high-pressure refrigerant gas-liquid mixture or refrigerant liquid is conveyed to an economizer primary side 2021 through the refrigerant pipeline from an outlet of the condenser 201. A part of the refrigerant at an economizer primary side outlet 2022 flows to a first expansion valve 203 to expand under a reduced pressure, and then flows into an evaporator 205. The other part is expanded into a refrigerant gas by a second expansion valve 204, and the refrigerant gas enters an economizer secondary side 2023 to exchange heat with the refrigerant flowing through the economizer primary side 2021, so that the refrigerant liquid in the economizer primary side 2021 is cooled to a required subcooling degree, and at the same time, the refrigerant gas in the economizer secondary side 2023 is increased in temperature and evaporated, and then the refrigerant

gas flowing out of the economizer secondary side 2023 is conveyed to the screw compressor 1 through an economizer pipeline 103, and is mixed with the refrigerant gas flowing into the screw compressor 1 through the evaporator 205, and the mixture is compressed and then discharged, so that the working efficiency of the screw compressor 1 is improved and a discharge temperature is reduced at the same time.

[0020] Fig. 2 is a schematic diagram of a partial structure of the screw compressor 1 shown in Fig. 1. As shown in Fig. 2, the screw compressor 1 includes a compressor housing 101, a first muffler reaction chamber 102, an economizer compression chamber port 1021, the economizer pipeline 103, and a second muffler reaction chamber 104.

[0021] As shown in Fig. 1 and Fig. 2, the economizer 202 communicates with the screw compressor 1 through the economizer pipeline 103, the economizer pipeline 103 having one end communicating with the economizer 202 and the other end communicating with the first muffler reaction chamber 102 disposed inside the compressor housing 101. The first muffler reaction chamber 102 is further provided with the economizer compression chamber port 1021 towards a compression outlet of the screw compressor 1, and the refrigerant gas flowing out of the economizer 202 flows to the first muffler reaction chamber 102 through the economizer pipeline 103, and then flows through the economizer compression chamber port 1021 to a compression chamber formed by wrapping the compressor housing 101 to be further compressed and discharged from the screw compressor 1.

[0022] Fig. 3 is a partially enlarged schematic diagram of the screw compressor 1 according to one or more embodiments of this application. As shown in Fig. 1, Fig. 2, and Fig. 3, the second muffler reaction chamber 104 is further provided on the economizer pipeline 103 at a position close to the first muffler reaction chamber 102, and the second muffler reaction chamber 104 communicates with the economizer pipeline 103, and surrounds and protrudes from an outer wall of the economizer pipeline 103.

[0023] In the screw compressor 1 in one or more embodiments of this application, the refrigerant gas is continuously compressed during the operation of the screw compressor 1, and a difference between a pressure of the refrigerant gas in the compression chamber and a pressure of the refrigerant gas flowing into the compression chamber through the first muffler reaction chamber 102 is large, so that the refrigerant gas in the compression chamber and the economizer pipeline 103 exhibit complex flow status and pressure pulsation. In the related art, pressure pulsation in a first target frequency band is effectively attenuated by communicating with the first muffler reaction chamber 102 inside the compressor housing 101. For pressure pulsation in a second target frequency band, in some embodiments of this application, the second muffler reaction chamber 104 is disposed on the economizer pipeline 103 at the position

close to the first muffler reaction chamber 102, and surrounds and protrudes from the outer wall of the economizer pipeline 103, and the second muffler reaction chamber 104 communicates with the interior of the economizer pipeline 103, so that sound waves can be reflected and interfered in the chamber, thereby enhancing a sound wave transmission loss at the position of the economizer pipeline 103 close to the first muffler reaction chamber 102 and widening an effective frequency range, and alleviating a problem that the pressure pulsation is transmitted to the downstream to cause the economizer pipeline 103 and downstream components thereof to generate large noise, thereby affecting the user experience. A risk is also reduced that the economizer pipeline 103 is in a strong vibration state for a long time, which may cause the connection between the economizer pipeline 103 and the first muffler reaction chamber 102 or the compressor housing 101 to become loose, thereby causing damage to the compressor.

[0024] It should be noted that this application does not limit the specific structure of the second muffler reaction chamber 104 as long as it is a configuration that is disposed on the economizer pipeline 103 at the position closed to the first muffler reaction chamber 102 and surrounds and protrudes from the outer wall of the economizer pipeline 103, and can attenuate the pressure pulsation in the economizer pipeline 103, such as a resonance chamber, and the above configuration should be included in the protection scope of this application.

[0025] At the same time, although an aspect in which the second muffler reaction chamber 104 is provided at the position of the economizer pipeline 103 close to the first muffler reaction chamber 102 is described, as shown in Fig. 2, the second muffler reaction chamber 104 may be disposed inside the compressor housing 101 and between the first muffler reaction chamber 102 and the economizer pipeline 103. Disposing inside the compressor housing 101 realizes a full-chamber design of the compressor, and the shielding of the compressor housing 101 can also be used to reduce part of the noise from the second muffler reaction chamber 104.

[0026] Fig. 4 is a curve comparison diagram of a transmission loss calculated when a muffling chamber is designed in the screw compressor according to one or more embodiments of this application and a transmission loss calculated when only the first muffler reaction chamber 102 is used in the related art. The transmission loss is an important indicator describing sound attenuation characteristics of a muffler, and the greater the transmission loss, the greater the attenuation of the pressure pulsation. A first-order frequency band and a second-order frequency band shown in Fig. 4 are two pressure pulsation attenuation frequency bands that need to be focused on when performing muffling and vibration reduction design, and are also target frequency bands for chamber optimization. A w/a curve is a transmission loss curve of the muffling chamber calculated when one or more embodiments of this application are adopted, a w/o

curve is a transmission loss curve of the muffling chamber calculated when the second muffler reaction chamber 104 according to this application is not used, and it can be seen from the comparison of the two curves that, as compared with the transmission loss in the case of not adopting one or more embodiments of this application, in the case of adopting one or more embodiments of this application, the transmission losses in both cases are high in the focused first-order frequency band, and especially in the second-order frequency band, the transmission loss is low by the design of not connecting the second muffler reaction chamber 104 in series, and it is difficult to increase the transmission loss in the second-order frequency band by continuing to optimize the first muffler reaction chamber 102 while ensuring that the transmission loss in the first-order frequency band does not decrease, and the first muffler reaction chamber 102 is required to be designed complicatedly. By adopting one or more embodiments of this disclosure, the target frequency band can be quickly optimized, the transmission loss on the target frequency band is greatly increased, and the transmission loss on another frequency band is also increased, which greatly enhances the transmission loss of the entire muffling design and expands the designed effective muffling frequency range. In this way, the second muffler reaction chamber 104 can achieve good pressure pulsation attenuation within a first-order frequency range and a second-order frequency range of the focused speed, which greatly widens the effective pulsation attenuation frequency range to adapt to the pressure pulsation generated by the compressor under different frequency conditions.

[0027] In addition, in an exemplary embodiment of this application, a diameter D2 of the second muffler reaction chamber 104 is at least larger than a pipeline diameter D1 of a communication portion between the economizer pipeline 103 and the first muffler reaction chamber 102.

[0028] In one or more embodiments the diameter D2 of the second muffler reaction chamber 104 is controlled to be greater than the pipeline diameter D1 of the communication portion between the economizer pipeline 103 and the first muffler reaction chamber 102, and it is ensured that a local space larger than a space of the economizer pipeline 103 itself is formed at a local part of the economizer pipeline 103 as the second muffler reaction chamber 104, thereby ensuring that a good acoustic environment can be formed after the pressure pulsation enters the second muffler reaction chamber 104, and an effect of pressure pulsation attenuation is achieved to a large extent in combination with the first muffler reaction chamber 102.

[0029] It should be noted that although an example in which the second muffler reaction chamber 104 in some embodiments is a cylindrical structure surrounding the outer wall of the economizer pipeline 103 has been described, this application is not limited thereto, and according to different operation conditions of the screw compressor 1, the frequency range of the pressure pul-

sation, and the like, an elliptical shape or other shapes should be included in the protection scope of this application as long as the aspect is one in which the pressure pulsation can be ensured to be effectively attenuated in the second muffler reaction chamber 104, for example, an aspect in which a plurality of second muffler reaction chambers 104 are disposed on a local part on the outer wall of the economizer pipeline 103, or an aspect in which a local part of the economizer pipeline 103 is expanded to form a space equivalent to the second muffler reaction chamber 104.

[0030] In a second embodiment of this application, elements denoted by the same names and symbols as those in the first embodiment of this application represent identical elements, and descriptions thereof are omitted here.

[0031] Fig. 5 is a schematic diagram of an economizer pipeline according to a second embodiment of this application. As shown in Fig. 5, a difference from the first embodiment is that in the screw compressor 1 according to the second embodiment of this application, a distance d between the second muffler reaction chamber 104 and the first muffler reaction chamber 102 is preferably equal to or greater than 10 mm.

[0032] In order to reduce the pressure pulsation generated during compression of the compressor and transmitted to the downstream of the economizer pipeline 103 along the compression chamber economizer port, by controlling the distance d between the second muffler reaction chamber 104 and the first muffler reaction chamber 102 to be equal to or greater than 10 mm, the first muffler reaction chamber 102, the second muffler reaction chamber 104, and the pipeline connecting the first muffler reaction chamber 102 and the second muffler reaction chamber 104 work together, and good pressure pulsation attenuation is achieved after passing through the two-stage muffler reaction chamber, which avoids a problem that the pressure pulsation causes the whole economizer pipeline 103 to generate large vibration, resulting in large noise during the operation of the compressor, thereby affecting the user experience. A problem is alleviated that the economizer pipeline 103 is in a strong vibration state for a long time due to high pressure pulsation, causing damage to compressor components.

[0033] As an exemplary embodiment of this application, a height H of the second muffler reaction chamber 104 in the radial direction of the economizer pipeline 103 satisfies a formula condition of $H - D1 \geq 5$ mm, and a length L in an extension direction of the economizer pipeline 103 satisfies a formula condition of $L \geq 10$ mm.

[0034] By controlling a size of the second muffler reaction chamber 104, the attenuation effect on the pressure pulsation with different frequencies can be adjusted, so that the second muffler reaction chamber 104 can be optimally designed for specific pressure pulsation. In consideration of a change in the frequency range of the compressor used under different operation conditions, by controlling the height H of the second muffler

reaction chamber 104 in the radial direction of the economizer pipeline 103 to satisfy the formula condition of $H - D1 \geq 5$ mm, and controlling the length L in the extension direction of the economizer pipeline 103 to satisfy the formula condition of $L \geq 10$ mm, there is a sufficient muffling space in the second muffler reaction chamber 104, so that the sound waves form a plurality of reflections and interferences in the second muffler reaction chamber 104, the dissipation of sound energy occurs, and the pressure pulsation transmitted to the economizer pipeline 103 is further reduced.

[0035] In some embodiments of this application, the example in which the distance d between the second muffler reaction chamber 104 and the first muffler reaction chamber 102 is equal to or greater than 10 mm, the height H in the radial direction of the economizer pipeline 103 satisfies the formula condition of $H - D1 \geq 5$ mm, and the length L in the extension direction of the economizer pipeline 103 satisfies the formula condition of $L \geq 10$ mm, this application is not limited thereto, and the setting of changing the size and the shape of the second muffler reaction chamber 104 according to the pressure pulsations in different frequency ranges should also be included in the protection scope of this application.

[0036] In a third embodiment of this application, elements denoted by the same names and symbols as those in some embodiments of this application represent identical elements, and descriptions thereof are omitted here.

[0037] Fig. 6 is a schematic diagram of the economizer pipeline 103 according to the third embodiment of this application. As shown in Fig. 6, a difference from some embodiments is that the screw compressor 1 according to the third embodiment of this application further includes an orifice plate 1041.

[0038] Fig. 7 is a schematic diagram of a specific structure of the orifice plate 1041 used in the economizer pipeline according to the third embodiment of this application. As shown in Fig. 6 and Fig. 7, in the screw compressor 1 according to the third embodiment of this application, the orifice plate 1041 is disposed at the connection location between the second muffler reaction chamber 104 and the economizer pipeline 103, and the specific structure of the orifice plate 1041 is determined by a thickness t of the orifice plate 1041, a diameter $2a$ of the orifice plate 1041, an orifice spacing b , and a perforation rate s , where a perforation rate is defined as a ratio of a perforation area of the orifice plate 1041 to an overall area of the orifice plate 1041. Preferably, the thickness t of the orifice plate 1041 is equal to or smaller than 3 mm, the diameter $2a$ of the orifice plate 1041 is equal to or smaller than 4 mm, and the orifice spacing b is equal to or greater than $6a$.

[0039] In one or more embodiments, by disposing the orifice plate 1041, a plurality of similar Helmholtz pulsation attenuation chambers are formed in the second muffler reaction chamber 104, an energy loss of the pressure pulsation is further increased, the effective frequency range of pressure pulsation attenuation is

widened, an acoustic transmission loss in the economizer pipeline 103 is enhanced, and the pressure pulsation generated during the compression of the compressor and transmitted to the downstream of the economizer pipeline through the first muffler reaction chamber 102 is reduced.

[0040] It should be noted that in some embodiments of this application, the specific size, the filling range, the material, and the like of the orifice plate 1041 are not limited, and different orifice plates 1041 are adopted according to different models of the screw compressor 1, the size of the second muffler reaction chamber 104, and the pressure pulsation attenuation requirements, which should be included in the protection scope of this application.

[0041] In a fourth embodiment of this application, elements denoted by the same names and symbols as those in the some embodiments of this application represent identical elements, and descriptions thereof are omitted here.

[0042] Fig. 8 is a schematic diagram of the economizer pipeline 103 according to the fourth embodiment of this application. As shown in Fig. 8, a difference from some embodiments is that the screw compressor 1 according to the fourth embodiment of this application further includes a sound absorbing material 1042.

[0043] As shown in Fig. 8, in the screw compressor 1 according to the fourth embodiment of this application, the second muffler reaction chamber 104 is further filled with the sound absorbing material 1042.

[0044] A position between the orifice plate 1041 and an wall surface of the chamber in the second muffler reaction chamber 104 is filled with the sound absorbing material 1042, so that when the pressure pulsation generated during the compression of the compressor passes through the sound absorbing material 1042 in the second muffler reaction chamber 104, the sound waves propagate in an internal fiber or voids of a porous structure, and causes vibration of fluid medium particles inside the material, and the vibration is converted into heat energy due to mechanisms such as friction and viscous resistance, thereby further reducing the pressure pulsation generated during the compression of the compressor and transmitted to the downstream of the economizer pipeline through the first muffler reaction chamber 102, and the refrigerant gas conveyed to the compression chamber through the economizer pipeline 103 is also increased in a temperature by the converted heat energy, and is mixed with the refrigerant gas flowing into the compressor from the evaporator 205, thereby improving the working efficiency of the compressor, and reducing the gas discharge temperature at the same time.

[0045] It should be noted that in some embodiments of this application, the specific size, the filling range, the material, and the like of the sound absorbing material 1042 are not limited, and different sound absorbing materials 1042 are adopted according to different models of the screw compressor 1, the size of the second muffler

reaction chamber 104, and the pressure pulsation attenuation requirements, which should be included in the protection scope of this application.

[0046] This application further provides a refrigeration system, specifically, the refrigeration system 2 shown in Fig. 1. The refrigeration systems of some embodiments are the same as the refrigeration system 2 described in the first embodiment. The screw compressor 1 may be any one of the screw compressors 1 according to various embodiments of this application, and the specific content is not repeated here.

[0047] The above embodiments are merely exemplary and are not intended to limit the invention, the scope of which is defined by the appended claims.

Claims

1. A screw compressor (1), comprising:

a compressor housing (101) provided with a compression chamber inside;
an economizer (202) communicating with the compressor housing (101) through an economizer pipeline (103); and
a first muffler reaction chamber (102) disposed in the compressor housing (101) and having an economizer compression chamber port (1021) communicating with the compression chamber, wherein
the economizer pipeline (103) has one end communicating with the first muffler reaction chamber (102) and the other end communicating with the economizer (202), and
the screw compressor (1) further comprises a second muffler reaction chamber (104) communicating with the economizer pipeline (103), and surrounding and protruding from an outer wall of the economizer pipeline (103).

2. The screw compressor (1) according to claim 1, wherein
a diameter, D2, of the second muffler reaction chamber (104) is at least larger than a pipeline diameter, D1, of a communication portion between the economizer pipeline (103) and the first muffler reaction chamber (102).

3. The screw compressor (1) according to claim 2, wherein
a distance, d, between the second muffler reaction chamber (104) and the first muffler reaction chamber (102) is equal to or greater than 10 mm.

4. The screw compressor (1) according to claim 2 or 3, wherein
a height, H, of the second muffler reaction chamber (104) in a radial direction of the economizer pipeline

(103) satisfies the following formula condition:

$$H - D1 \geq 5 \text{ mm.}$$

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5. The screw compressor (1) according to claim 2, 3 or 4, wherein
a length, L, of the second muffler reaction chamber (104) in an extension direction of the economizer pipeline (103) satisfies the following formula condition:

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$$L \geq 10 \text{ mm.}$$

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6. The screw compressor (1) according to any of claims 2 to 5, further comprising:
an orifice plate (1041) disposed at a communication portion between the second muffler reaction chamber (104) and the economizer pipeline (103).

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7. The screw compressor (1) according to claim 6, further comprising:
a sound absorbing material (1042) with which the second muffler reaction chamber (104) is filled.

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8. A refrigeration system (2), comprising:
a screw compressor (1) according to any preceding claim.

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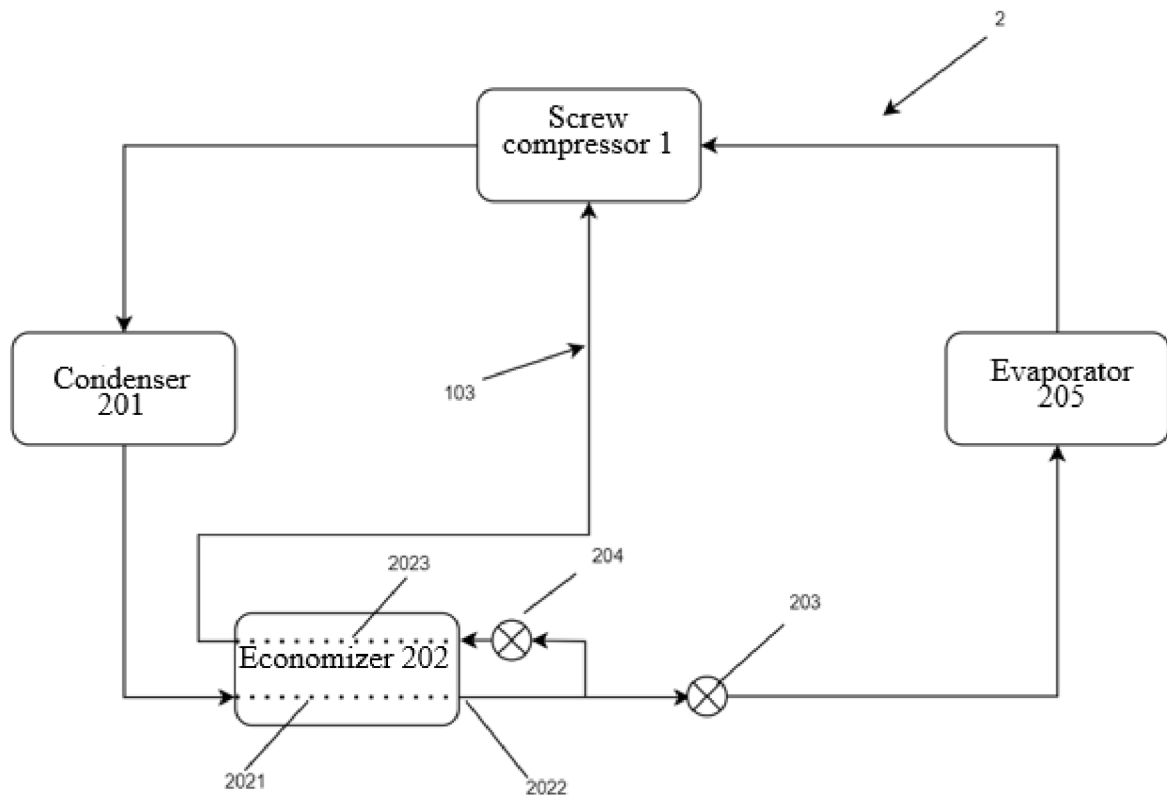


Fig. 1

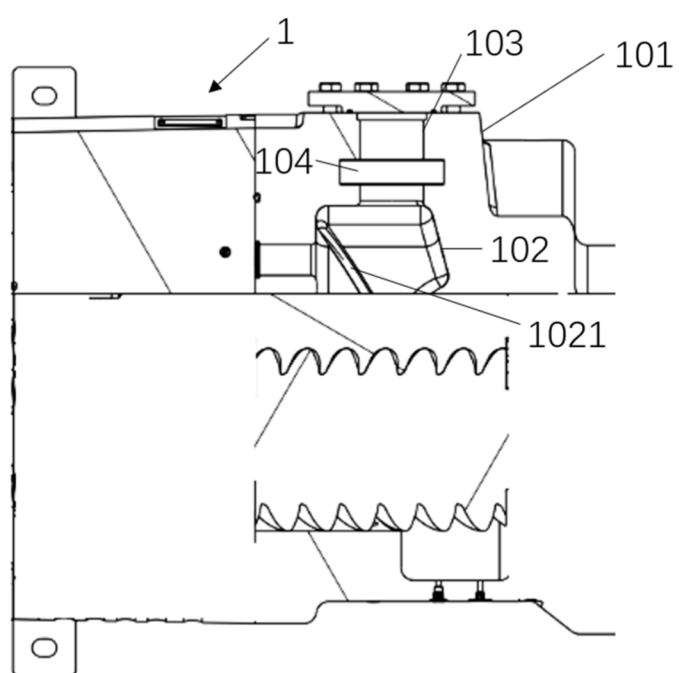


Fig. 2

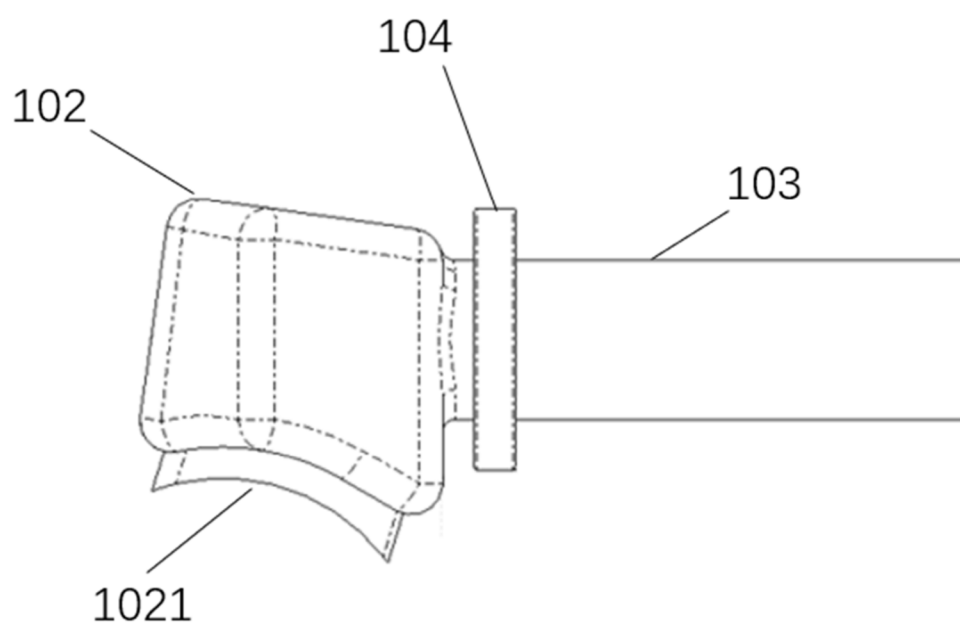
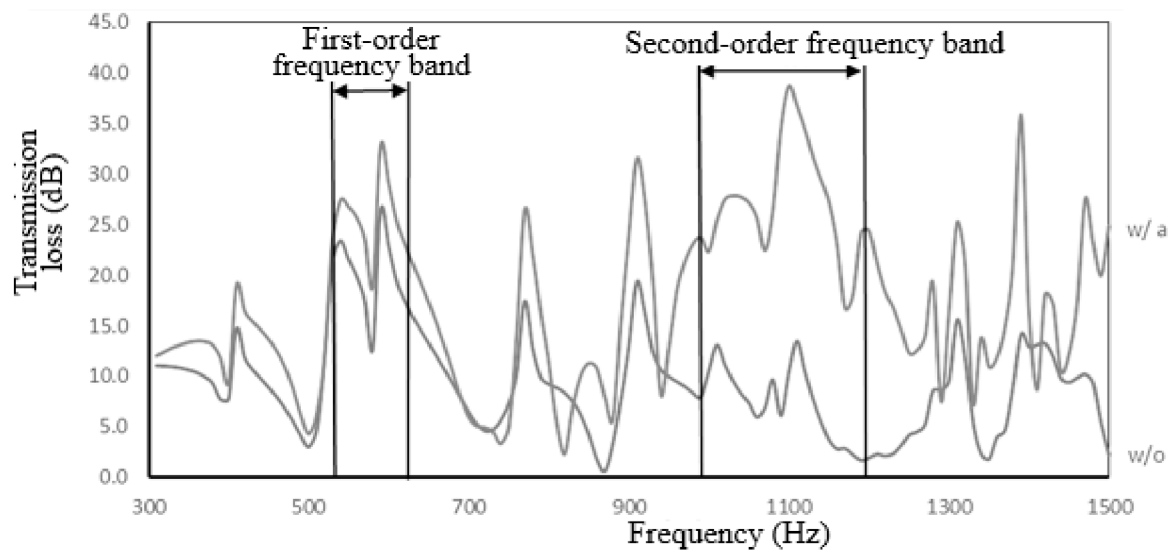


Fig. 3

**Fig. 4**

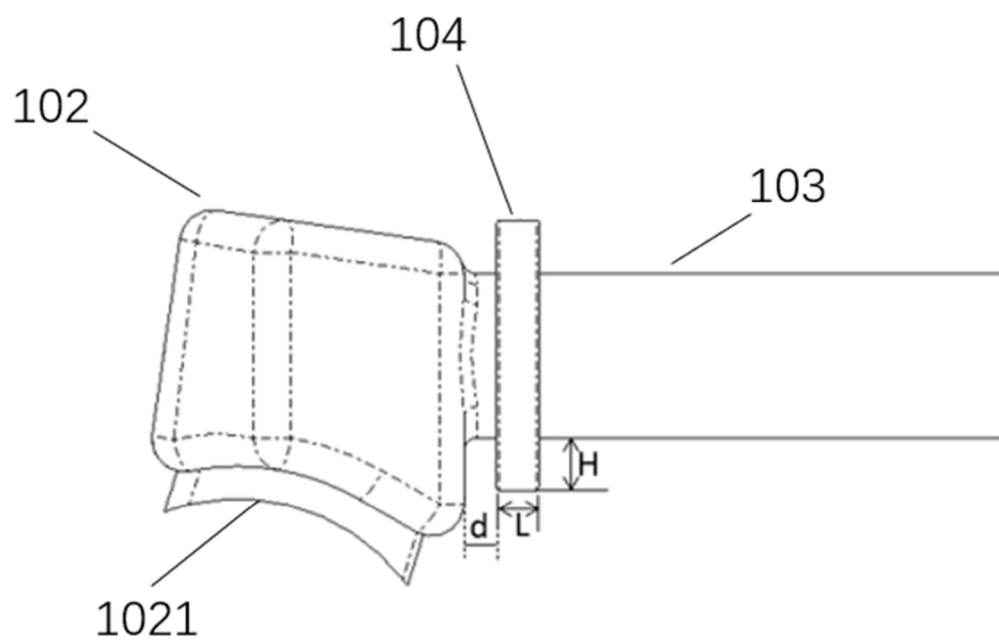


Fig. 5

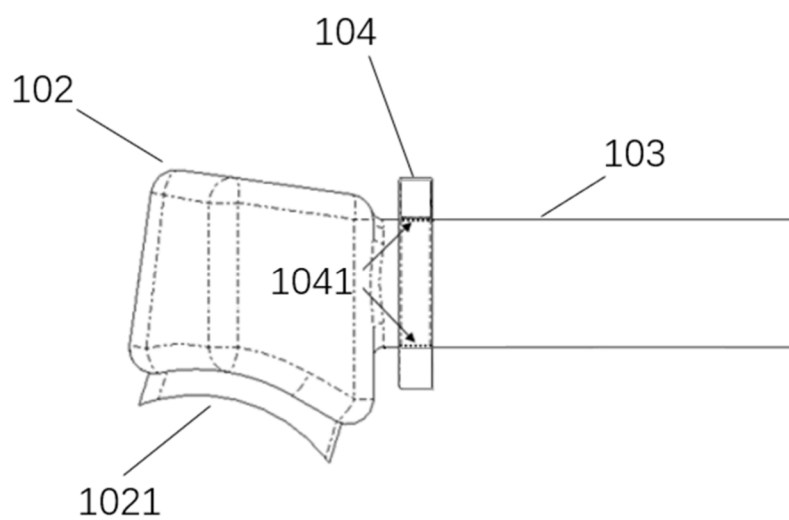


Fig. 6

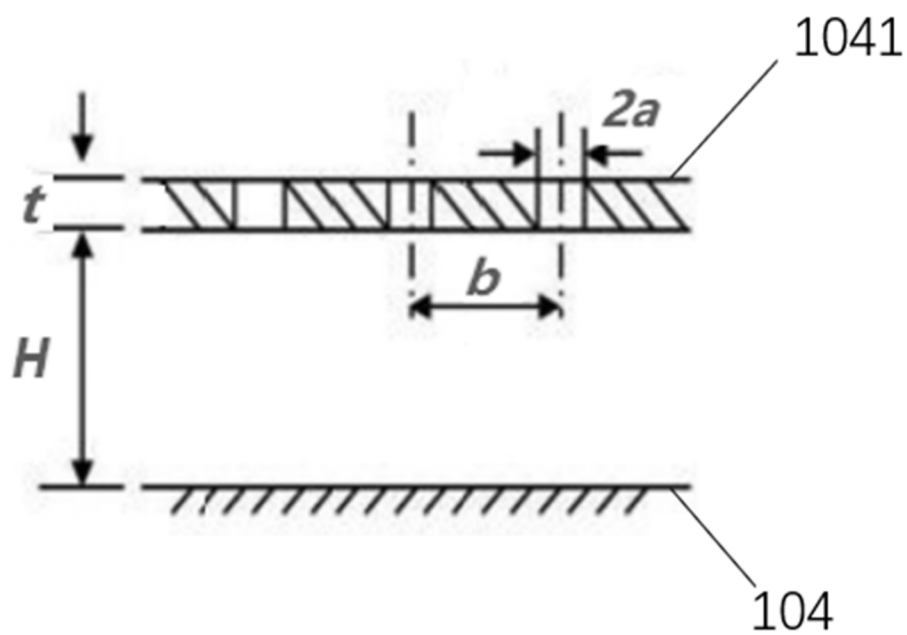


Fig. 7

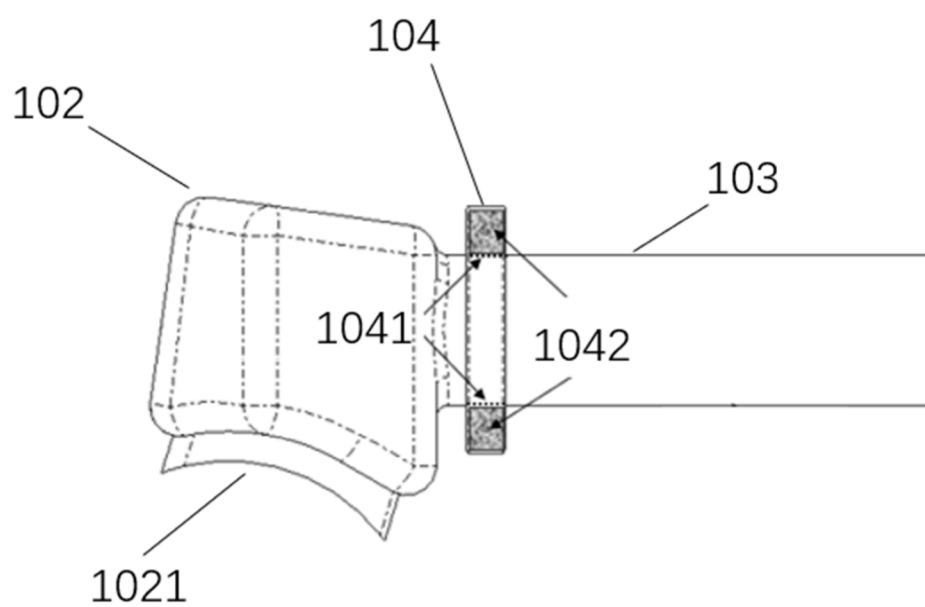


Fig. 8



EUROPEAN SEARCH REPORT

Application Number

EP 25 21 4676

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2018/156501 A1 (VAIDYA AMIT [US] ET AL) 7 June 2018 (2018-06-07) * paragraph [0050] - paragraph [0051]; figures 1-4 *	1-9	INV. F04C18/16 F04C29/06
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			TECHNICAL FIELDS SEARCHED (IPC)
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CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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