March 14, 1967 H. BAUER 3,309,013

ARRANGEMENTS INCLUDING COAXIAL SUCTION AND DELIVERY VALVES

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FIG 1

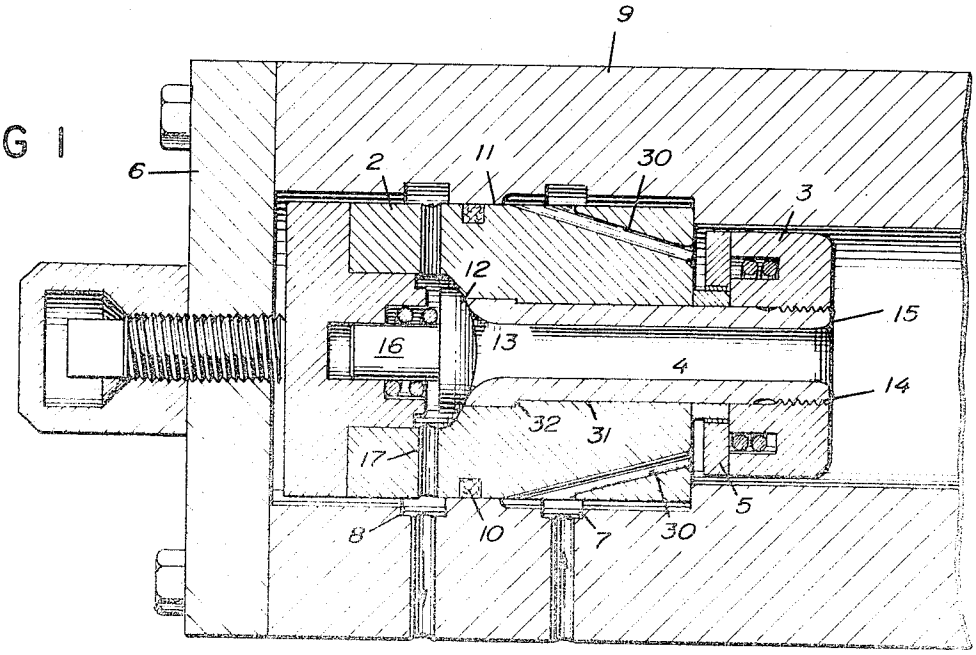


FIG 2

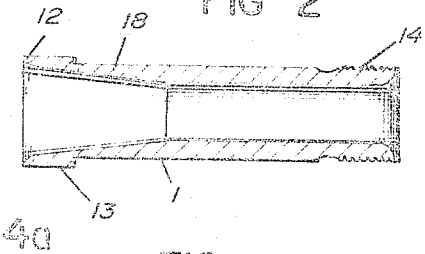


FIG 4a

FIG 4

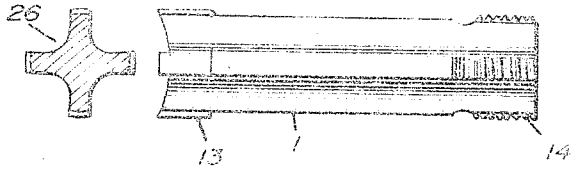


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FIG 3

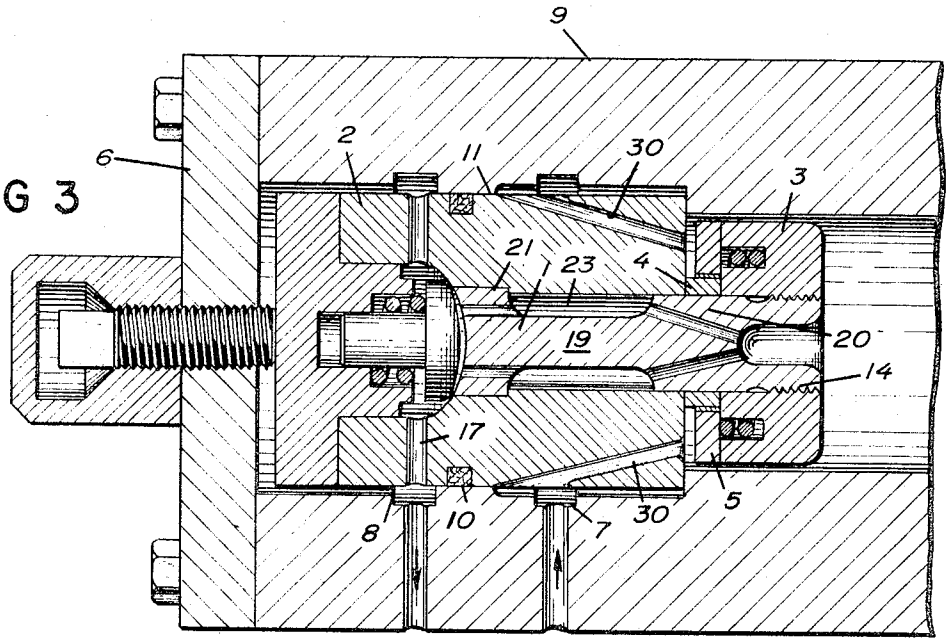
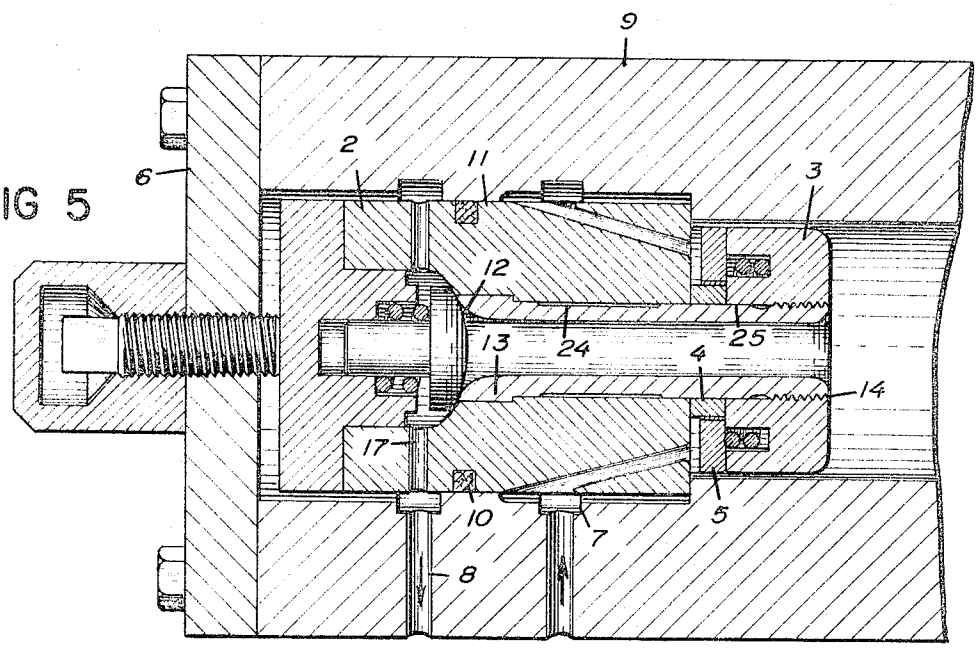



FIG 5

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United States Patent Office 3,309,013
Patented Mar. 14, 1967



# 3,309,013
# ARRANGEMENTS INCLUDING COAXIAL SUCTION AND DELIVERY VALVES

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Filed Aug. 3, 1965, Ser. No. 476,868
Claims priority, application Switzerland, Aug. 3, 1964, 10,121/64
7 Claims. (Cl. 230—231)

The present invention has for its object arrangements including coaxial suction and delivery valves.

In practice, in the case of compressors and of pumps operating under a high pressure, the suction and delivery valves are mounted coaxially instead of forming independently located valves. Such coaxial valves have for their advantage a considerable reduction in the time required for dismantling and this is of a high interest from the standpoint of efficiency, chiefly in chemical plants.

In the known arrangements including such suction and delivery valves, the stroke-limiting abutments forming a unit with the valve seat, are subjected to the influence of the variable pressures obtained during the suction and compression strokes. Said variable pressures may lead to an increase in the stresses in registry with the shoulders formed on the valve body as a consequence of the instantaneous modifications in the transverse cross-section and this may lead, after a certain time, to breaks or to endurance failure.

The present invention provides an arrangement including coaxial suction and delivery valves intended for use in high pressure compressors and pumps. In such arrangements, the valve body shows no longer any shoulder or projection liable to lead to an increase in the stresses, as provided by modifications in the transverse cross-section of said body. Furthermore, with such an arrangement, the assembly and dismantling operations may be performed very speedily.

According to the invention, such a suction and delivery valve arrangement includes inside a central valve-carrying body oblique suction channels and a central delivery channel, said central body carrying the valves being connected with a stroke-limiting member or abutment so as to form a unit therewith while a connecting element provided with at least one channel for the fluid to be fed through it is fitted inside the bore forming the central delivery passage in the valve-carrying body. Said passageways or channels formed in last-mentioned element are given a shape furthering the flow of the fluid, and said element connecting the said central body with the system including the suction valve and its stroke-limiting abutment forms thus a removable unit therewith.

In such an arrangement of coaxial suction and delivery valves, any cross-sectional variations liable to increase the stresses are cut out in registry with the section of the valve-carrying body subjected to variable pressure. Said arrangement may be furthermore speedily fitted in the compressor or pump and dismantled after removal of a cover fitted over the cylinder head or of a securing screw without any dismantling operation being required for further parts of said pump or compressor.

Further features and advantages of the invention will appear in the reading of the following description of preferred embodiments thereof, reference being made to the accompanying drawings wherein:

FIG. 1 is a longitudinal cross-sectional view of an arrangement including suction and delivery valves in accordance with a first embodiment of the novel connecting element referred to hereabove and which, in this case, is constituted by a threaded sleeve.



FIG. 2 is a sectional view of a modification of the threaded sleeve forming the connecting element.

FIG. 3 is a longitudinal sectional view of an arrangement similar to that illustrated in FIG. 1, but equipped with a modified connecting element the shape of which is that of a bar.

FIG. 4 is a side view of a further modification of a cross-shaped connecting element.

FIG. 4*a* is a cross-sectional view of FIG. 4.

FIG. 5 is a longitudinal cross-sectional view of an arrangement similar to that illustrated in FIG. 1, but equipped with a still further modification of the connecting element constituted by a threaded sleeve.

In FIGS. 1, 3 and 5, the coaxial suction and delivery arrangement includes a valve casing 9 provided with a cylindrical bore 11 inside which is fitted the central body 2 carrying the valves. The casing 9 may be constituted by the head of the pump or compressor cylinder operating under high pressure.

The central body 2 is provided with suction channels 30 starting in an oblique direction from its periphery towards the transverse surface of the central body facing the annular closing member 5 forming the suction valve. Said channels 30 are arranged in annular formation round a central bore or channel 31 which serves for the delivery of the fluid during the compression stroke. In registry with the output ends of the sloping suction channels 30 and at the periphery of the central body 2, there is provided, between said body 2 and the casing 9, an annular chamber 7 serving for the admission of fluid sucked into the cylinder. The central channel 31 in the body 2 opens in front of the closing member 16 forming the delivery valve of which the chamber is connected through the agency of radial channels 17 with an annular chamber 8 out of which the fluid is delivered. Between the annular chambers 7 and 8 which are subjected respectively to suction and compression pressures, the central body 2 is fluidtightly fitted as well known per se with reference to the casing 9 by means of an annular packing 10. The cylindrical bore 11 in the area extending between the annular chambers 7 and 8 serves for the accurate centering of the central body carrying the valves. The suction valve is associated with a stop 3 forming a stroke limiting member.

According to the invention, there is fitted in the central channel or bore 31 of the valve-carrying body 2 a connecting element 1 through which the fluid is caused to flow. In the embodiment illustrated in FIG. 1, said element 1 is constituted by a threaded sleeve the inner surface of which is smooth and polished and flares widely at its end 12 facing the delivery end, so as to ensure the best conditions for the flow of the fluid. At this flaring end, the sleeve is furthermore provided with an outer bead 13 engaging the channel 31 and of which the abutment surface 32 facing away from the delivery end engages a shoulder formed in the central channel of the central body 2. The threaded end of the connecting element 1 facing the annular closing member forming the suction valve 5 the contact surface of which lies in the plane of the bearing surface constituting the transverse surface of the central body, projects beyond the latter by the length of the stroke-limiting abutment 3 increased by the thickness of the ring 4 guiding the suction valve. Thus, the central body 2, the suction valve 5 and the stroke limiting member or abutment 3 are assembled and form a unit which may be removed bodily. The opening 15 at the input end of the threaded sleeve also flares outwardly to a large extent in registry with the threaded end of the sleeve with a view to providing optimum conditions for the flow of fluid. The threaded sleeve 1 consequently forms both a central connecting element and a channel connecting the bore in the cylin-

der with the chamber of the delivery valve, which extends in the central body beyond the closing member **16** forming the delivery valve and which is subjected to the pressure inside the compressor. The fluid flows out of last-mentioned chamber towards the annular compression chamber, as provided by the channels **17** which extend in a radial plane slopingly or otherwise. The cylinder head formed by the casing **9** is closed on the side facing the delivery valve by a cover **6**.

In accordance with the invention and with a view to improving the conditions of flow, it is necessary to provide at the end of the threaded sleeve **1** facing the delivery valve a gradual outward flaring of the output section. Said flaring section may, as illustrated in FIG. 2, form a diffuser **10** extending to the front of the closing plate or member **16** forming the delivery valve and merge into the rounded portion **12** defining the actual output opening.

FIG. 5 illustrates a connecting element **1** formed again by a threaded sleeve. In the case of FIG. 5, there is formed by turning the sleeve on a lathe round the outer periphery of the threaded sleeve an annular recess **24** extending between the sleeve **1** and the central bore in the body **2**, said recess separating partly the sleeve **1** from the surface of the central bore formed in the body **2**. Thus, the transmission of the heat, produced by the compression of the fluid, towards the body **2** provided with oblique channels is reduced and at the same time, the entering gases are heated to a lesser extent, which has a favorable action on the yield of the compressor.

In the modification illustrated in FIG. 3, the connecting member **1** includes a central section **19** of which the two ends form two beads or collars **20** and **21** serving for the centering of said element. The diameter of the bead **21** which faces the delivery valve is substantially larger than that of the bead **20** located in front of the suction valve. Thus, said bead **21** may serve as a stop for the unitary system constituted by the connecting element and the suction valve as in the case of the embodiment illustrated in FIGS. 1 and 5. The bead **20** located on the side facing the suction valve is threaded at **14** so as to engage the stroke-limiting abutment **3**. When said stroke-limiting abutment **3** is screwed over the thread **14** after the guiding ring **4** has been positioned round the bead **20**, together with the annular closing member **5** forming the suction valve, the central body **2**, the suction valves **5** and the stroke-limiting abutment **3** for the latter form a unit which may, after dismantling of the cover **6** and removal of the delivery valve outside the casing **9**, be inserted as a unit in the cylindrical bore of the casing and it may be dismantled in a corresponding manner. The beads **20** and **21** are provided with channels **22** which may be parallel or oblique with reference to the axis of the bore in the central body **1**, said channels **22** serving for the flow of the compressed fluid passing out of the compression chamber of the cylinder, said fluid flowing between its passage through the channels in the two beads through the annular chamber **23** surrounding the central section **19** of the connection element, the fluid reaching finally the delivery valve.

Lastly, FIG. 4, illustrates a further modification wherein the cross-section of the connecting element **1** has a star-shaped cross-section throughout its length, so that longitudinal grooves are thus provided at **26** which allow the passage of fluid along said element. In such a case, the connecting element **1** includes, as in the modifications illustrated in FIGS. 1, 2 and 3 an abutment bead **13** and a terminal thread at **14**. Obviously, numerous modifications may be brought to the arrangement described hereinabove within the scope of the accompanying claims.

What I claim is:

**1.** In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, an element fitted inside the axial channel of the body and provided with a longitudinal passageway and an abutment rigid with the outer surface of said element at its end facing away from the cylinder and engaging the shoulder in the axial channel, said element mechanically engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.

**2.** In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, an element fitted inside the axial channel of the body and provided with a longitudinal passageway and an abutment rigid with the outer surface of said element at its end facing away from the cylinder and engaging the shoulder in the axial channel, said element threadedly engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.

**3.** In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, an element fitted inside the axial channel of the body and provided with a longitudinal passageway of a aerodynamic shape with outwardly flaring openings at each end and an abutment rigid with the outer surface of said element at its end facing away from the cylinder and engaging the shoulder in the axial channel, said element mechanically engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.

**4.** In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings

of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, a sleeve fitted inside the channel of the body and the bore in which has outwardly flaring terminal openings and includes a diffuser section merging into the terminal opening facing the delivery valve, an abutment rigid with the outer surface of said sleeve at its end facing away from the cylinder and engaging the shoulder in the axial channel, said sleeve mechanically engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.

5. In a combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, an element fitted inside the axial channel of the body and including a central section of a reduced diameter leaving an empty annular space between it and the wall of the axial channel, terminal beads each provided with auxiliary channels connecting said annular space with the corresponding outer ends of the body, said beads centering the element inside the axial channel, the bead at the end of the element facing away from the cylinder engaging the shoulder in the axial channel, and a guiding ring fitted between the stroke-limiting member and the body within the opening in the annular suction valve, said element threadedly engaging the stroke-limiting member to form a unit with the latter, with the body and with the ring guiding the suction valve, and resilient means cooperating with said delivery valve and said suction valve.

6. In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, an element fitted inside the axial channel of the body and provided with longitudinal peripheral grooves and an abutment rigid with the outer surface of said element at its end facing away from the cylinder and engaging the shoulder in the axial channel, said element threadedly engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.



7. In combination with the cylinder of a fluid compressing machine operating under a high pressure, the provision of a valve-carrying body fitted fluidtightly inside said cylinder and provided with an axial delivery channel showing a shoulder facing away from the cylinder and with an annular series of suction channels extending obliquely round the axial channel and converging towards the cylinder, a delivery valve adapted to close the end of the axial channel facing away from the cylinder, an annular suction valve adapted to move axially of the body into and out of engagement with the openings of the suction channels facing the cylinder, a stroke-limiting member for the suction valve on the side of the latter facing the cylinder, a sleeve fitted inside the channel of the body and including a central section of a reduced diameter, the bore in said sleeve having outwardly flaring terminal openings and including a diffuser section merging into the terminal opening facing the delivery valve, an abutment rigid with the outer surface of said sleeve at its end facing away from the cylinder and engaging the shoulder in the axial channel, said sleeve mechanically engaging the stroke-limiting member to form a unit with the latter, with the body and with the suction valve therebetween, and resilient means cooperating with said delivery valve and said suction valve.

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ROBERT M. WALKER, *Primary Examiner.*