

A Pipe Switching Arrangement

The invention relates to a pipe switching arrangement. In particular, but not exclusively, the invention relates to a pipe switching arrangement for installations for pneumatically conveying loose material, comprising a housing having a first hollow, e.g. cylindrical connection and a second cylindrical connection, the mouth openings of which in the inside wall of the housing are generally aligned with each other; a third cylindrical connection; and a switching valve member in the housing which is rotatably secured within the housing and which has a single flow duct or two preferably parallel flow ducts, by way of which duct or ducts the first connection can be selectively connected to the second or to the third connection in two different rotational positions of the switching valve member. In known embodiments of this device, the flow ducts are straight, cylindrical ducts and the switching member is mounted by means of at least one trunnion extending generally perpendicular to the plane containing the axis of the connections.

A pipe switching arrangement of that general kind is known from German patent specification No. 38 17 349. In this embodiment, the switching valve member has two flow ducts. In all pipe _____ switching arrangements of that kind, in the first rotational position of the switching valve member the axis of the first connection, that of the flow duct or the first flow duct and the axis of the second connection are aligned. The corresponding flow path is therefore of a cross-section which is cylindrical throughout. In contrast, in the second rotational position in which the first connection is connected to the third connection by way of the flow duct or the second flow duct of the switching valve member, there is what is referred to as a geometrical join, as between the mouth opening of the first connection, at the housing, and the adjoining mouth opening of the

respective flow duct in the switching valve member. This situation arises because the way in which the cylindrical inside wall of the housing is penetrated by the cylindrical cross-section of the connection, and the corresponding way in which the cylindrical peripheral surface of the switching valve member is penetrated by the cylinder circumscribed by the flow duct, by virtue of the eccentric position of the respective cylinder axes, result in section surfaces which are asymmetrical in relation to the generatrix of the inside surface of the housing and peripheral surface of the switching valve member respectively which bisects them. In

order to avoid an abrupt change in cross-section which is caused by this asymmetry, at least one of the mouth openings must therefore be reworked. That is not only expensive from the production procedure point of view but it also results in a change in the otherwise circular cross-section of the flow path in the first position of the switching valve member.

EP 0 406 577 A1 discloses a pipe switching arrangement having a switching valve member which has a flow duct wherein the problem of the geometrical join is countered by the mouth openings on the one hand of the cylindrical first connection, at the housing, and on the other hand of the flow duct of the switching valve member, in the second rotational position of the latter, being disposed in a flat elliptical section surface. The flat elliptical section surface, in accordance with the principle of a mitre cut, lies

on the line bisecting the angle included by the axis of the connection and that of the flow duct. In that case of course in order to achieve a smooth transition between the flow duct of the switching valve member and the second connection, in the first rotational position of the switching valve member, suitable cross-sectional adaptations have to be made in that region. In addition, the switching valve member cannot be produced in the form of an integral cast component as the mitre cut surface can only be embodied in the form of a tube inserted into the switching valve members, for reasons relating to manufacturing procedure.

There is therefore a need in relation to a pipe switching arrangement with a switching valve member having a rotationally symmetrical peripheral surface , to provide a structural solution in which a geometrical join is avoided in both rotational positions of the switching valve member at all connections, without expensive reworking operations having to be effected or the corresponding cross-sections in the regions of the respective mouth openings having to be altered, for that purpose.

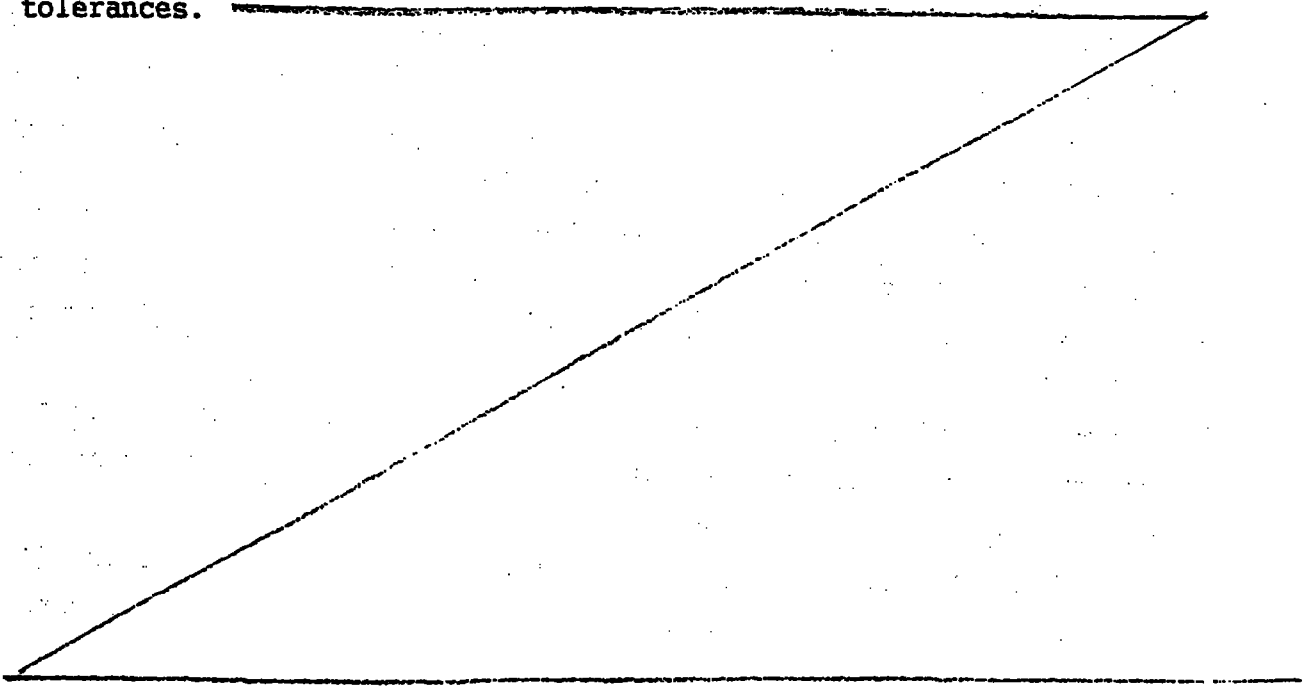
In accordance with the invention there is provided a switching arrangement , e.g. for installations for pneumatically conveying loose material, comprising a housing having first and second cylindrical connection passages, the openings of which in the inner wall of the housing are aligned with each other; a third cylindrical connection passage; and a switching valve member rotatably secured within the housing and including single flow duct or two flow ducts , by way of which duct or ducts the first connection passage can be selectively connected to the second or the third connection passages in two different rotational positions of the switching valve member, wherein a portion of the outer surface of the switching valve member is convexly curved and the inner surface of the housing is correspondingly concavely curved, further portions of the outer surface of the switching valve member in the vicinity of the openings of the or each flow duct being flat, the arrangement being such that the openings of the or each flow duct and the respectively oppositely disposed openings of the connection passages in the inner surface of the housing, in both rotational positions of the switching valve member, are substantially coincident flat section surfaces which lie on the bisector of the complementary angle to the angle which is included by straight lines respectively connecting the centre point of the opening surface of the first connection passage to that of the second connection passage and to that of the third connection passage.

Thus, the peripheral surface of the switching valve member (and accordingly the inner surface of the housing) is therefore not a

cylindrical surface but a free-form surface, the contour of which can be ascertained in accordance with known geometrical relationships. More specifically, the contour depends on the angle of departure of the connections, the primary diameter of the switching valve member, as well as the diameter of the flow duct thereof and, insofar as the arrangement involves a switching valve member with only one flow duct, the eccentricity of that flow duct in relation to the central axis of the switching valve member.

Preferably, the switching valve member is rotatably secured within the housing by means of a trunnion which is perpendicular to the plane of the axes of the connections. It is also preferable that the or each flow duct is straight and cylindrical.

In a particularly preferred embodiment of the invention, the peripheral surface of the switching valve member and the inner surface of the housing are spherically curved, that is to say they have a constant radius of curvature. More specifically it can be shown that, for most situations of use, the specified free-form surface can be replaced by a spherical surface to such a good degree of approximation that the remaining deviations relative to the precise configuration of the free-form surface remain within the range of the production tolerances.



In the proposed pipe switching arrangement, the openings of the three connections do not lie in planes which are at a right angle to the connection axes. Therefore, to embody different entry and/or departure angles, the connections which are embodied by cylindrical tubular connections can each be turned through 180° about the axis which extends at a right angle to the section surface of the respective mouth opening, without the geometry of the housing and/or the switching valve member having to be altered in other respects.

Two preferred embodiments of a pipe switching arrangement according to the invention selected by way of example are described below and shown in diagrammatically simplified form in the accompanying drawings in which:

Figure 1 is a view in longitudinal section through a first embodiment, in the first rotational position of the switching valve member,

Figure 2 shows the same view in longitudinal section in the second rotational position of the switching valve member,

Figure 3 is a view in cross-section taken along line III-III in Figure 1,

Figure 4 is a view in longitudinal section through a second embodiment in the first rotational position of the switching valve member,

Figure 5 shows the same view in longitudinal section in the second rotational position of the switching valve member, and

Figure 6 is a view in cross-section taken along line VI-VI in Figure 4.

In the first embodiment of the pipe switching arrangement, which is shown in Figures 1 to 3, the switching valve member has only one flow duct. The pipe switching arrangement comprises a housing 1 having the three connections 1a, 1b and 1c. A switching valve member 2 which is preferably in the form of an integral cast component is rotatably mounted in the housing 1 by way of lateral trunnions 2a and 2b, see

Figure 3. A drive (not shown in greater detail) serves to rotate the switching valve member, the drive having a rotary pin 3 which is force-lockingly, i.e. frictionally

connected to the switching valve member 2 on the side of the trunnion 2b. The switching valve member 2 has a cylindrical flow duct 2c which, in the first rotational position of the switching valve member as shown in Figure 1, connects the connections 1a and 1b in a straight passage to each other, whereas in the second rotational position of the switching valve member as shown in Figure 2, it connects the connections 1a and 1c to each other.

So that the respectively oppositely disposed mouth openings of the flow duct 2c in the peripheral surface of the switching valve member and of the connections 1a to 1c in the peripheral surface of the housing are in opposite coincident relationship with each other in the respective rotational positions of the switching valve member, the proposed construction fulfils two geometrical conditions:

- the major axis of the ellipse formed by the contour of the respective mouth opening lies on the bisector of the complementary angle β to the angle α enclosed by the straight lines A and B connecting the centre point M1 of the mouth opening area of the first connection 1a to the centre point M2 of the mouth opening area of the second connection 1b, and the centre point M3 of the mouth opening area of the third connection 1c; and

- the peripheral surface 2d of the switching valve member 2 and the inside surface 1d of the housing, which is complementary thereto, are free-form surfaces which correspond with a very good degree of approximation to the surface of a sphere whose radius, on the basis of the essential geometrical parameters of the rotary switching arrangement, arises out of the requirement that the respective mouth opening areas must overall be flat section surfaces in order to fulfil the condition of a mitre cut.

The shape of the peripheral surface of the switching valve member 2, which is therefore at least approximately spherical, requires the housing to be of a two-part configuration, with the division plane coinciding with the plane of the main diameter. As shown in Figure 3 therefore the housing comprises a main body 11 and a cover-like body portion 12 which is screwed to the main body 11.

By virtue of the conditions in respect of a mitre cut being fulfilled, the longitudinal axes of the respective connections do not include a right angle with the respective planes of the mouth openings. That fact makes it possible in a simple manner to embody in particular two different angles of departure for the connections, without the geometry of the housing and the switching valve member having to be altered in other respects. More specifically, as is apparent from Figure 2, for example the axis C of the connection 1c can be reflected about the axis D which is disposed perpendicularly to the plane 10 of the mouth opening. In that way for example it is possible to provide a departure at 90° , instead of an inclined departure at 45° .

The embodiment of the pipe switching arrangement shown in Figures 4 to 6 comprises, in a housing 1, a switching valve member 2 having two parallel flow ducts 20c and 21c. The advantage of this embodiment is that the angle of rotation of the switching valve member only has to be as large as the angle included by the axes of the connections 1b and 1c. As can be seen in particular from Figure 5, the mouth openings of the flow ducts 20c and 21c and the respectively oppositely disposed mouth openings in this case of the connections 1a and 1c of the housing 1 form flat section surfaces, more specifically by virtue of the same geometrical relationships being maintained as have been described in connection with Figures 1 to 3. For the sake of clarity it should also be added that the

fulfilment of those conditions, for the join between the connection 1a and the flow duct 21c in the second rotational position of the switching valve member 2 as shown in Figure 5, by virtue of the peripheral symmetry of the switching valve member 2, inevitably means
5 that the other mouth opening of the flow duct 21c as well as the mouth openings of the flow duct 20c and the connections 1b and 1c also fulfil the same conditions.



CLAIMS

1. A pipe switching arrangement, e.g. for installations for pneumatically conveying loose material, comprising a housing having first and second cylindrical connection passages, the openings of which in the inner wall of the housing are aligned with each other; a third cylindrical connection passage; and a switching valve member rotatably secured within the housing and including single flow duct or two flow ducts, by way of which duct or ducts the first connection passage can be selectively connected to the second or the third connection passages in two different rotational positions of the switching valve member, wherein a portion of the outer surface of the switching valve member is convexly curved and the inner surface of the housing is correspondingly concavely curved, further portions of the outer surface of the switching valve member in the vicinity of the openings of the or each flow duct being flat, the arrangement being such that the openings of the or each flow duct and the respectively oppositely disposed openings of the connection passages in the inner surface of the housing, in both rotational positions of the switching valve member, are substantially coincident flat section surfaces which lie on the bisector of the complementary angle to the angle which is included by straight lines respectively connecting the centre point of the opening surface of the first connection passage to that of the second connection passage and to that of the third connection passage.

2. A pipe switching arrangement according to Claim 1, wherein the switching valve member is rotatably secured within the housing by means of a trunnion which is perpendicular to the plane of the axes of the connection.

3. A pipe switching arrangement according to Claim 1 or Claim 2, wherein the or each flow duct is straight and cylindrical.



4. A pipe switching arrangement according to any of Claims 1 to 3, wherein the peripheral surface of the switching valve member and the inner surface of the housing are spherically curved.

5. A pipe switching arrangement generally as herein described, with reference to or as illustrated in the accompanying drawings.
