(54) Title: INSPECTION DEVICE FOR CONVEYOR DUCTS FOR AERIFORM MEDIA

(57) Abstract: An inspection device (1) for a conveyor duct for aeriform media, in particular for air, comprises a porthole element (2) of substantially transparent material and a frame (3) connectible to a wall (4) of the conveyor duct in the region of an access opening (6) provided in the wall (4), in a manner such that the porthole element (2) is superimposed on the access opening (6) and the access opening (6) is closed; illumination means (7), directed towards the interior of the conveyor duct, are provided and are suitable for illuminating a conveying space therein, permitting visual inspection thereof, both when the system is idle and when the system is in operation.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
DESCRIPTION

"Inspection device for conveyor ducts for aeriform media"

The subject of the present invention is an inspection device for ducts for aeriform media, in particular, air in climate-control, air-conditioning, heating, ventilation, and air-extraction and air-exchange systems. To ensure the cleanliness of the air conveyed, for example, along the ducts of an air-conditioning system, the ducts require frequent inspection and cleaning operations at intervals which are variable and difficult to define.

Since the conveyor systems do not have regular openings in addition to the air-intake and air-outlet openings, many of the ducts of the conveyor systems are inaccessible and hermetically separated from the environment. This makes it very difficult if not impossible to monitor events which take place inside the ducts, in particular to check the state of contamination of the surfaces delimiting the conveying space.

It is consequently difficult to determine the most appropriate moment for maintenance and for cleaning of the ducts and to identify any dangerous conditions or other abnormalities which might prejudice normal and safe operation of the air-conveyor system.

There are known inspection systems which provide for
access openings in the walls of the ducts to afford access to the interior thereof, and in which the openings can be closed by inspection doors. An inspection door is usually constituted by two plastics shells with dimensions larger than the dimensions of the access opening, the two shells being superimposed and connected to one another by means of screws which can move the shells towards one another and apart so that one shell can be positioned on the inside and the other on the outside of the wall including the access opening and the shells can be tightened against the wall from both sides in order to close the opening therein.

However, the mounting and removal of the two shells of the inspection doors is complex and expensive in terms of time.

Moreover, each time access to the interior of the duct is required, the edges of the access opening are exposed and become more and more damaged and may lose polluting material, for example, fragmented thermal-insulation material.

The access openings of the prior art allow the interior of the duct to be inspected only when the system is idle and inspection is in any case difficult owing to the poor accessibility and illumination which are due both to the limited dimensions of the access opening and to the often
poor accessibility of the conveyor ducts.

The object of the present invention is therefore to propose an inspection device for conveyor ducts for aeriform media, in particular air, having characteristics such as to overcome the problems mentioned with reference to the prior art.

This and other objects are achieved by means of an inspection device for a conveyor duct for aeriform media, in particular for air in climate-control, air-conditioning, heating, ventilation, and air-extraction and air-exchange systems, comprising a porthole element of substantially transparent material and a frame which can be connected to a wall of the conveyor duct in the region of an access opening provided in the wall, in a manner such that the porthole element is superimposed on the access opening and the access opening is substantially hermetically closed, illumination means, directed towards the interior of the conveyor duct, being provided and being suitable for illuminating a conveying space therein, permitting visual inspection thereof, both when the system is idle and when the system is in operation.

For a better understanding of the invention, some embodiments are described below by way of non-limiting example, with reference to the appended drawings, in
which:

Figure 1 is an exploded and partially-sectioned, perspective view of the device according to the invention,

Figure 2 is a plan view of a detail of the device according to the invention,

Figure 3 is a plan view of a further detail of the device according to the invention,

Figure 4 is a sectioned side view of the device according to the invention, during assembly,

Figure 5 is a sectioned side view of the device according to the invention, mounted on a wall of a conveyor duct, and

Figure 6 is a perspective view of a portion of a duct for aeriform media on which the inspection device according to the invention is mounted.

With reference to Figure 1, an inspection device for a conveyor duct is generally indicated 1. The inspection device 1 comprises a porthole element 2 of substantially transparent material, for example, glass or plastics material, and a frame 3 to be connected to a wall 4 of the conveyor duct in the region of an access opening 6 provided in the wall 4, in a manner such that the porthole element 2 is superimposed on the access opening 6 and the access opening 6 is closed.
The inspection device 1 advantageously has illumination means, preferably an electric lamp 7 which can be supplied with energy, for example, by means of an electrical cable connected to the mains or to a battery, the illumination means 7 being directed towards the interior of the conveyor duct and being suitable for illuminating a conveying space therein to permit inspection thereof.

The illumination means preferably comprise tubular electric lamps, advantageously flexible tubes, for example, a flexible plastics-coated cord with luminous resistors.

According to one embodiment, the porthole element 2 is connected to the frame 3 releasably, preferably by threaded or bayonet means, to permit the opening and closure of an inspection opening 8 delimited by the frame 3 and to afford access to the interior of the conveyor duct through the inspection opening 8.

According to the embodiment shown in Figure 1, the porthole element 2, which is substantially flat and advantageously circular, has a plurality of outer tongues 10 projecting substantially radially outwardly and preferably arranged at regular intervals around its periphery 9. The outer tongues 10 are intended to engage inner tongues of the frame 3 which will be described
below. The periphery 9 itself advantageously has an outer step 11, preferably a continuous circular step, for forming a reaction surface for an inner edge of the frame 3 which will be described below.

The frame 3 preferably has a substantially annular shape with an inner surface 13 which faces towards the interior of the conveyor duct, is substantially smooth, and is preferably chamfered around its outer periphery 14 in order advantageously to reduce the resistance to the airflow and to prevent the formation of recesses which lead to the deposition of dirt and to the harbouring of bacteria.

The inspection opening 8 of the frame 3 is delimited by an inner edge 15 of a shape substantially complementary with the periphery 9 of the porthole element 2 and, in particular, with the step 11, for which it forms a support.

Preferably, the periphery 9 and the inner edge 15 have complementary shapes such that an inner surface 16 of the porthole element 2 is substantially aligned with the inner surface 13 of the frame 3 in order to form a substantially uniform and preferably smooth and uninterrupted internal surface of the inspection device 1.

In order to form the above-mentioned releasable
connection with the porthole element 2, the frame 3 advantageously has inner tongues 16 projecting substantially radially towards the centre of the frame 3 and preferably arranged at regular intervals around the inspection opening 8 in positions corresponding to the positions of the outer tongues 10 of the porthole element. The intervals between the inner tongues 16 permit the insertion of the outer tongues 10 of the porthole element during the movement of the latter towards the frame 3.

Rotation of the porthole element 2, for example, by means of one or more handles 17, preferably formed on an outer surface of the porthole element 2, inserts the outer tongues 10 in the space between the inner tongues 16 and the inner edge 15 of the frame 3 where they are locked, for example, by the friction between the tongues 10, 16. According to one embodiment, the inspection device 1 has suitable stop means for ensuring that the porthole element 2 is positioned and stopped relative to the frame 3 in a predetermined closure position. The stop means are preferably resiliently deformable or resiliently movable in order to bring about resilient and/or snap stopping.

In the embodiment shown in Figure 2, the outer tongues 10 of the porthole element 2 have, on the side facing
towards the inner tongues 16 of the frame 3, projections 18 suitable for engaging respective grooves 19 formed in the inner tongues 16 of the frame 3. The projections 18 advantageously snap-engage the grooves 19 owing to the relative pliability of the tongues 10 and 16.

The inspection device 1 and, in particular, the frame 3, delimits internally a space for housing the illumination means, for example, an electric lamp 7, preferably a fluorescent tubular lamp. A suitable channel 22 formed in the frame 3 is provided for housing an electrical cable for supplying the lamp 7.

Advantageously, the space for housing the illumination means 7 is delimited by a transparent wall 20 facing towards the interior of the conveyor duct and by an opaque wall 21 facing towards the exterior of the duct so as to ensure illumination of the conveying space without dazzling the person inspecting the duct through the inspection device 1.

In order to achieve a high level of illumination without limiting the field of view, it is advantageous to provide an elongate lamp 7, preferably a fluorescent tubular lamp which extends substantially around the periphery of the inspection opening 8 of the inspection device 1.

According to the embodiment shown in Figure 1, the frame 3 comprises an outer half-frame 3' to be associated with
the wall 4 on the outside of the duct and an inner half-frame 3'' to be associated with the wall 4 on the inside of the duct. The inner and outer half-frames 3'' and 3' advantageously have complementary shapes and can be connected to one another by connection means, preferably threaded or snap connection means and, in the specific embodiment, by connection screws 12, to form the frame 3. The frame 3, preferably composed of these two half-frames 3' and 3'', has a substantially U-shaped peripheral portion 23 which can house and protect an edge 24 delimiting the access opening 6, as well as connecting the device 1 to the wall 4.

The peripheral portion 23 is advantageously formed by an outer flange 25 of the outer half-frame 3', an inner flange 26 of the inner half-frame 3'', and a circular wall 27 substantially perpendicular to the inner and outer flanges 26 and 25.

The circular wall 27 advantageously delimits, together with the transparent and opaque walls 20 and 21, a channel which extends substantially around the periphery of the inspection opening 8 and which houses the tubular lamp 7.

According to one embodiment, the channel and, more generally, the space for housing the illumination means 7, has an opening which enables the illumination means 7
to be replaced, preferably without complete dismantling of the inspection device 1. The opening is advantageously covered by means of the outer half-frame 3' so as to permit replacement of the illumination means 7 without removal of the inner half-frame 3'' from the wall 4 of the duct. The inspection device is advantageously but not necessarily made of synthetic material, for example, plastics material or Plexiglas, preferably polycarbonate with a glass content. Alternatively, the frame 3 and the porthole element 2 may also be made of different materials, for example, stainless steel for the frame and polycarbonate for the porthole element.

According to a further aspect of the invention, the illumination means emit a substantially azure light. Azure light has in fact been found to have an unusual ability to render metal surfaces, particularly stainless-steel surfaces, highly visible and to show up impurities on the surfaces extremely well. Even more advantageously, the illumination means 7 emit a suffused light, further increasing the positive effect of the azure light. This is very advantageous in environments which require a very high degree of air cleanliness, such as operating theatres and hospitals in general,
semiconductor and microprocessor production plants, in the pharmaceutical field, etc.
The inspection device 1 permits visual inspection of the interior of a conveyor duct in optimal light conditions both when the system is idle and when the system is in operation.
Access to the interior of the conveyor duct through the inspection opening 8 is convenient and safe. The edge 24 of the wall 4 of the duct is completely protected and reinforced by the frame 3, eliminating the risk of loss of pollutant substances and increasing the strength and life of the conveyor duct.
The interior of the conveyor duct can be illuminated both when the inspection opening 8 is closed by the porthole element 2 and when it is open.
The releasable connection of the porthole element to the frame permits cleaning of the internal surface of the porthole element and easy replacement thereof, if necessary, thus ensuring maximum transparency of the porthole element and hence optimal visibility of the interior of the duct through the porthole element.
The inspection device 1 is particularly suitable for use in conveyor ducts in critical environments such as hospitals, in the semiconductor and microprocessor industries, etc. where a high degree of air cleanliness
is required. In fact, the device 1 permits both access to the interior of the duct for cleaning and maintenance operations and visual checking of the results of these operations, in very favourable conditions.

Naturally, in order to satisfy contingent and specific requirements, a person skilled in the art may apply to the inspection device 1 according to the present invention further modifications and variations, all of which, however, are included within the scope of protection of the invention as defined by the appended claims.
CLAIMS

1. An inspection device (1) for a conveyor duct for aeriform media, in particular for air, comprising a porthole element (2) of substantially transparent material and a frame (3) which can be connected to a wall (4) of the conveyor duct in the region of an access opening (6) provided in the wall (4), in a manner such that the porthole element (2) is superimposed on the access opening (6) and the access opening (6) is closed, in which the device (1) further comprises illumination means (7), directed towards the interior of the conveyor duct and suitable for illuminating a conveying space therein, to permit visual inspection thereof, both when the system is idle and when the system is in operation.

2. A device (1) according to Claim 1 in which the porthole element (2) is connected to the frame (3) releasably, affording access to the interior of the duct through an inspection opening (8) delimited by the frame (3).

3. A device according to Claim 1 or Claim 2 in which the porthole element (2) is connected to the frame (3) by threaded or bayonet means (10, 16).

4. A device (1) according to Claim 2 or Claim 3, comprising stop means (18, 19) suitable for stopping the porthole element (2) relative to the frame (3) in a
predetermined closure position.

5. A device (1) according to Claim 4 in which the stop means (18, 19) are resiliently movable or deformable in order to bring about resilient and/or snap stopping of the porthole element (2) in the closure position.

6. A device (1) according to any one of the preceding claims in which the illumination means (7) are associated with the frame (3).

7. A device (1) according to any one of the preceding claims in which the illumination means (7) comprise an elongate lamp, preferably a fluorescent tubular lamp.

8. A device (1) according to the preceding claim in which the tubular lamp extends in the vicinity of the periphery of the inspection opening (8).

9. A device (1) according to Claim 8 in which the frame (3) delimits, by means of a transparent wall (20) facing towards the interior of the duct and an opaque wall (21) facing towards the exterior of the duct, a channel which extends substantially around the periphery of the inspection opening (8) and which houses the tubular lamp.

10. A device (1) according to any one of the preceding claims in which the frame (3) has a substantially U-shaped peripheral portion (23) suitable for housing and protecting an edge (24) of the wall (4) delimiting the access opening (6).
11. A device (1) according to any one of the preceding claims in which the frame (3) comprises an inner half-frame (3'') to be associated with the wall (4) on the inside of the duct and an outer half-frame (3') to be associated with the wall (4) on the outside of the duct, the inner half frame (3'') and the outer half-frame (3') being connectible to one another by means of connection members (12), preferably threaded or snap connection members, to form the frame (3).

12. A device (1) according to Claim 11 in which the frame (3) delimits internally a space for housing the illumination means (7), the space having an opening to permit the replacement of the illumination means (7), the opening being covered by the outer half-frame (3') so as to permit replacement of the illumination means (7) without removal of the inner half-frame (3'') from the wall (4) of the duct.

13. A device (1) according to any one of the preceding claims, made of synthetic material, preferably polycarbonate with a glass content.

14. A device according to any one of the preceding claims in which the illumination means emit a substantially azure light.

15. A device according to any one of the preceding claims in which the illumination means emit a suffused light.
16. A wall (4) for forming a conveyor duct for aeriform media, in particular air, comprising an access opening (6), in which the wall (4) is provided with an inspection device according to any one of the preceding claims.

17. A conveyor duct for aeriform media, in particular air, comprising a wall (4) with an access opening (6), in which the conveyor duct comprises an inspection device according to any one of the preceding claims.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F24F13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F24F F16L F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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