

PROTECTIVE SHIELD FOR AN AIR DISCHARGE PORT OF AN AIR CONDITIONER OUTDOOR UNIT

FIELD OF INVENTION

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This invention relates to a protective shield for an air discharge port of a ventilation unit. More particularly, the present invention relates to a protective shield integrally formed with a grille and a bell mouth for covering and protecting an air outlet of an air conditioner outdoor unit with an improved air flow performance.

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BACKGROUND OF INVENTION

An air conditioning system distributes air in an occupied space and alters the properties of air to a more desired condition. There are two types of air conditioning system namely, a centralised
15 air conditioning system and a non-centralised air conditioning system. The centralised air conditioning system is usually used in larger interior space such as a mall, a tower, or a railway station. Air is distributed to the interior space through a plurality of fan coil unit, in which the fan coil unit is in connection with an air handling unit and a chilling machine comprising a compressor, an evaporator, and a condenser via cooled water pipe and electric conduits. Whereas
20 the non-centralised air conditioning system is usually used in a smaller interior space such as home, offices, or schools. The non-centralised air conditioning system comprises one or more indoor units and an outdoor unit connected by refrigerant pipes and electric conduits.

Typically, the air conditioning system is mainly used to provide cooled air to an indoor
25 environment. In the non-centralised air conditioning system, hot air is cooled by exchanging heat with a refrigerant in the indoor unit and being distributed to the indoor space by a ventilation fan in the indoor unit, while the hot refrigerant circulates into the outdoor unit where it will be compressed, condensed, and cooled. Flowing air is created by a ventilation fan in the outdoor unit to remove heat out of the system via an air discharge port on the outdoor unit. The cooled
30 refrigerant is routed back to the indoor unit for another cycle of air conditioning. Vice versa, the

air conditioning system can be used to provide warm air to an indoor environment by merely running the refrigerant in an opposite direction.

5 It is necessary to prevent damage to the fan and other electrical components of the outdoor unit by intrusion of large foreign substances as well as to prevent one from being injured by the moving ventilation fan. To prevent the aforementioned situations, a fan guard or a grille is mounted on the air discharge port of the outdoor unit. Conventionally, the outdoor unit has a metal side surface, also known as a front panel, which has an opening to serve as the air discharge port. The air discharge port has a bell mouth structure which extends from the front
10 panel to the ventilation fan encased in the housing of the outdoor unit. The bell mouth is an important feature of the outdoor unit which can affect the air flow performance of the unit. The grille, usually made from plastic material, is a separate piece of article and mounted on the outer surface of the front panel.

15 The bell mouth is formed on the front panel by a stamping process. After the stamping process, the residual metal is disposed of as waste because the residues are not sufficient to be recycled and reused to form other parts of the air conditioning system. In order to reduce waste created, researchers have come out with a new configuration of the front panel, bell mouth, and grille, in which the bell mouth is not integrally formed on the front panel. Instead, the bell mouth is
20 formed integrally with the grille, and the one-piece grille and bell mouth unit is usually made from plastics material. The stamping process is still needed to create the opening on the front panel. However, the residual metal is sufficient to be recycled and reused to form other parts of the air conditioning system; for example, a service panel and a valve cover of the outdoor unit. Not only that less waste is produced, the overall cost of production of an air conditioning system
25 is also reduced.

Nevertheless, the use of one-piece grille and bell mouth unit in the design of an air conditioning system is not widely adopted in the air conditioning industry as the air flow performance of the outdoor unit is greatly reduced as compared to the conventional separate grille and bell mouth
30 configuration. Higher power consumption is needed to operate the outdoor unit as the heat

transfer rate is reduced as a result of the reduced air flow performance. End user would prefer a more expensive air conditioning system but cheaper electricity cost in a long run situation.

As recent technology focus has been shifted towards green technology or technology which could reduce waste produced and less harmful to the environment, the one-piece grille and bell mouth unit is still necessary to be adopted in the air conditioning system. Hence, there is a need to solve the drawback of the existing technology of one-piece grille and bell mouth unit by providing an improved design and configuration of the one-piece grille and bell mouth unit having enhanced air flow performance.

This invention provides a solution to the problem.

SUMMARY OF INVENTION

One of the objects of the invention is to improve the recyclability of residual metal produced from stamping an opening on a front panel of an air conditioner outdoor unit by not forming a bell mouth structure integral with the panel; instead the bell mouth is formed integrally with a protective shield for the opening on the outdoor unit.

Another object of the invention is to reduce the overall cost of manufacturing an air conditioning system by improving the recyclability of residual metal produced from stamping an opening on a front panel of the outdoor unit.

Still another object of the invention is to improve the air flow performance of an air conditioner outdoor unit that uses a one-piece grille and bell mouth unit by introducing an improved design and configuration to the one-piece unit.

Yet another object of the invention is to reduce the high power consumption of an air conditioner outdoor unit by improving the air flow performance of the outdoor unit as a result of an improved heat transfer rate.

At least one of the preceding aspects is met, in whole or in part, by the present invention, in which the embodiment of the present invention describes a protective shield for mounting on an air discharge port of an air conditioner outdoor unit having a fan comprising a frame having an opening with a curved circumferential edge; and a grille having a plurality of curved ribs arranged around the periphery of the grille; the ribs extends from one side of the grille to the curved circumferential edge, such that the grille is positioned at a level above one surface of the frame.

It is preferable to attach a bell mouth to the frame at the curved circumferential edge. The bell mouth has a straight portion and a curved portion, in which its straight portion is tangentially attached to the curved circumferential edge of the frame. More preferably, the bell mouth, the frame, and the grille are formed integrally as a one-piece unit. With such configuration, the ribs are preferably attached to the intersection between the curved circumferential edge and the straight portion of the bell mouth.

Preferably, the ribs and the circumferential edge are curved in an opposite direction. Particularly, the ribs are curved towards the centre of the grille and the circumferential edge is curved away from the centre of the grille. The curvature radius of the ribs is preferably larger than the curvature radius of the circumferential edge.

The preferred embodiment of the invention consists of novel features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings and particularly pointed out in the appended claims; it being understood that various changes in the details may be effected by those skilled in the arts but without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of facilitating an understanding of the invention, there is illustrated in the accompanying drawing the preferred embodiments from an inspection of which when considered

in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

FIGURE 1 is an isometric view of the protective shield.

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FIGURE 2 is front view of the protective shield depicted in FIGURE 1.

FIGURE 3 is a side view of the protective shield depicted in FIGURE 1.

10 FIGURE 4 is sectional view of the protective shield taken along the line A-A of FIGURE 2.

FIGURE 5 is a detailed view of section B of the protective shield depicted in FIGURE 4.

15 FIGURE 6 is a graph of air flow rate across air discharge port versus fan speed of an air conditioner outdoor unit using different protective shields.

DETAILED DESCRIPTION OF THE INVENTION

20 Hereinafter, the invention shall be described according to the preferred embodiments of the present invention and by referring to the accompanying description and drawings. However, it is to be understood that limiting the description to the preferred embodiments of the invention and to the drawings is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications without departing from the scope of the appended claim.

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This invention relates to a protective shield for an air discharge port of a ventilation unit. More particularly, the present invention relates to a protective shield integrally formed with a grille and a bell mouth for covering and protecting an air outlet of an air conditioner outdoor unit with an improved air flow performance.

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A protective shield (10) is provided and mounted on an air discharge port (not shown) of an air conditioner outdoor unit (not shown) to prevent damage to internal electrical components of the outdoor unit by intrusion of large foreign substances as well as to prevent one from being injured by the internal electrical or mechanical components, particularly, a fan (not shown) located at the air discharge port. It should be noted that the function of the protective shield (10) shall not be limited thereto or thereby, but it also serves as an enhancing feature for the outdoor unit that improves an air flow performance of the outdoor unit. Correspondingly, it should be appreciated to note that the term “protective shield”, “fan guard”, “exhaust grille”, “outlet grille”, “fan grille” or any like term can be used interchangeably herein throughout the description.

The air flow performance herein shall refer to the volume of air being delivered across the air discharge port of the outdoor unit per unit of time, and a higher volume per unit of time indicates a better air flow performance. It is important to achieve a high air flow performance for the outdoor unit as a faster heat exchange rate is desired. The heat exchange rate can be improved by increasing amount of air being delivered across the air discharge port or reducing time needed to deliver a given amount of air across the air discharge port. This is usually being achieved by increasing the fan speed but higher power consumption is required. With the present configuration of the protective shield (10), better air flow performance can be achieved without the need of higher power consumption.

As shown in drawings, the protective shield (10) comprises a frame (1) having an opening (not shown) with a curved circumferential edge (2). Similar size and shape of the opening as compared to the size and shape of the air discharge port is preferred in order to prevent any obstruction to the air flow through the air discharge port. In conventional practice, the opening and the air discharge port are formed in an annular configuration as such configuration is deemed to be able to provide an optimal air flow performance. The frame (1) may be in any shape and size that is sufficient to accommodate the opening and cover the air discharge port of the air conditioner outdoor unit. It shall be noted that the opening of the frame (1) shall be positioned in such a way that the opening is coaxial with the air discharge port when the protective shield (10) is mounted thereon for an optimal air flow performance. For illustrative purpose, FIGURE 1 and 2 shows an example of the protective frame having a generally square frame (1) having an

annular opening at the centre of the frame (1). The circumferential edge (2) of the opening of the frame (1) is curve in configuration, forming a substantially quarter circle-like outer appearance at the circumferential edge (2). Such curve (2) configuration is preferred to avoid formation of any sharp vertex or corner on the circumferential edge (2) which could induce an undesirable turbulence and resistance air flow through the opening of the frame (1).

Still referring to FIGURE 1 and 2, a grille (3) having a plurality of interconnected rings, preferably arranged sequentially and concentrically between a centre (3A) and a periphery thereof (3B), is provided on the opening of the frame (1). The cross section of the rings is preferable in an aerofoil shape so as to prevent air flow turbulence and resistance as well as noise. However, it shall be appreciated that the configuration of the rings shall not be limited thereto or thereby, and may be in any form of arrangement which provides restriction to access of the air discharge port but with limited interference with flow of air through the air discharge port. The periphery (3B) of the grille is preferably annular in configuration such that the grille (3), the opening, and the air discharge port are coaxial. A plurality of curved ribs (4) is arranged around the periphery (3B) of the grille. Extending from the periphery (3B) of the grille, the ribs (4) are attached to the curved circumferential edge (2). Thus, the grille (3) is supported on the frame (1) by the plurality of the ribs (4). The grille (3) supported on the frame (1) in combination constitutes a protective shield (10) which could prevent access of a human body part. With such configuration, the grille (3) is positioned at a level above one surface of the frame (1) by the extending curved ribs (4). The extending ribs (4) are important to keep the grille (3) at an elevated level above the surface of the frame (1) to avoid any sharp vertices or corners formed around the opening of the frame (1) that could induce an undesirable turbulence and resistance air flow through the opening of the frame (1).

As depicted in the accompanying drawings, a preferred protective shield (10) may further comprise a bell mouth (5) having a straight portion (5A) defining a generally cylindrical structure. One end of the straight portion (5A) is tangentially attached to the curved circumferential edge (2) of the opening of the frame (1). The other end of the straight portion (5A) is a curved portion (5B) defining an outwardly expanding rim around the edge of the other end of the straight portion (5A). When in use, the preferred protective shield (10) is mounted on

the air discharge port of the outdoor unit with the bell mouth (5) facing inside of the outdoor unit and the elevated grille (3) facing outside of the outdoor unit. While the fan is coaxially disposed within the bell mouth (5), the curved portion or the outwardly expanding rim of the bell mouth (5) allows maximum amount of air to be drawn by the fan with a minimum of loss. Preferably, the outer wall of the straight portion (5A) of the bell mouth (5) shall be perfectly fitted to the periphery (not shown) of the air discharge port such that no gap is permitted in between the bell mouth (5) and the air discharge port. However, it shall be noted that it is possible that a gap may be provided between the bell mouth (5) and the air discharge port but such configuration would be compensated by reduced air flow performance of the outdoor unit.

Although it is not shown in any of the accompanying drawings, the bell mouth (5) and the frame (1) with the grille (3) can be formed as two separate units or integrally as one-piece unit. As depicted in the foregoing description, in the case where the bell mouth (5) and the frame (1) with the grille (3) may be formed as two separate units, the bell mouth (5) may be formed integrally with the front panel (not shown) of the outdoor unit. However, the two separate units can be merely a bell mouth (5) and a frame (1) with grille (3), whereby the bell mouth (5) and the frame (1) with grille (3) can be separately mounted on the air discharge port by a fastening mechanism, while the straight portion (5A) of the bell mouth (5) are coincidently and tangentially attached to the curved circumferential edge (2) of the opening of the frame (1). Nevertheless, it is preferred to form the bell mouth (5) and the frame (1) with the grille (3) integrally as one-piece unit in order to reduce waste produced and overall cost of production.

Referring to FIGURE 4 and 5 that shows a detailed view of the protective shield (10) showing the frame (1) with the grille (3) and the bell mouth (5) attached thereto, it is preferable that the curved ribs (4) are attached to the intersection between the curved circumferential edge (2) and the straight portion (5A) of the bell mouth (5). More preferably, the curved ribs (4) are also tangentially attached to the curved circumferential edge (2) at point of intersection. Specifically, a smooth profile is provided by the ribs (4) which extend from the straight portion (5A) of the bell mouth (5), curve at the point of intersection, and thereafter attach to the periphery (3B) of the grille (3). The smooth profile is preferred and necessary, regardless of the bell mouth (5) and the frame (1) with grille (2) are two separate units or one-piece unit.

Preferably, the ribs (4) supporting the grille (3) and the circumferential edge (2) of the opening are curved in an opposite direction. More preferably, the ribs (4) are curved towards the centre (3A) of the grille (3) and the circumferential edge (2) is curved away from the centre (3A) of the grille (3), forming a generally curved v-shaped profile. It may be possible to have both ribs (4) and circumferential edge (2) being curved in the same direction or the ribs (4) being curved away the centre (3A) of the grille (3) and the circumferential edge (2) being curved towards the centre (3A) of the grille (3). However, the aforementioned configurations are not preferred as sharp vertices could be form and affecting the air flow performance of the outdoor unit. It is also preferable that the curvature radius of the ribs (4) is larger than the curvature radius of the circumferential edge (2).

The protective shield (10) can be made from plastics material which renders the shield (10) light, cheap, and can be easily produced. Nevertheless, the material shall not be limited thereto but could be any other material, such as metal, capable of forming the required configurations. The frame (1), the grille (3), and the bell mouth (5) can also be made from different material. For example, the frame (1) with the grille (3) can be made from plastics material while the bell mouth (5) can be made from metal.

Referring to FIGURE 1, the protective shield (10) may optionally comprise a plurality of supporting tabs (6) attached to the outer surface of the straight portion (5A) of the bell mouth (5) and extending from the outwardly expanding rim (5B) of the bell mouth (5) to the back surface of the frame (1) to support the overall structure of the protective shield (10). Optionally, the supporting tabs (6) may have a slot (6A) along the tabs (6) served as a drain to prevent water accumulation, as shown in the drawings.

Although the invention has been described and illustrated in detail, it is to be understood that the same is by the way of illustration and example, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.

EXAMPLE

- A protective shield (10) for mounting on an air discharge port of an air conditioner outdoor unit, comprises a square frame (1) having an opening with a curved circumferential edge (2); and a grille (3) having a plurality of curved ribs (4) arranged around the periphery (3B) of the grille (3), the ribs (4) extends from one side of the grille (3) to the curved circumferential edge (2), such that the grille (3) is positioned at 12 mm above one surface of the frame (1). A bell mouth (5) is integrally formed with the frame (1) and the grille (3), wherein the bell mouth (5) has a straight portion (5A) and a curved portion (5B), and the bell mouth (5) is tangentially attached to the curved circumferential edge (2) at the straight portion (5A). Specifically, the ribs (4) are curved towards the centre (3A) of the grille (3) and the circumferential edge (2) is curved away from the centre (3A) of the grille (3). The curvature radius of the ribs (4) is 23.9 mm and the curvature radius of the curved circumferential edge (2) is 10 mm.
- The air flow performance of an air conditioner outdoor unit using the protective shield (10) is determined and compared with one using conventional one-piece grille and bell mouth unit as well as separate-piece grille and bell mouth units. The moving component of the outdoor unit, or a fan, is operated at different speed and the volume of air being delivered across the air discharge port per unit of time is determined and shown in Table 1 and FIGURE 6.

Table 1

No.		Fan Speed (RPM)	Air Flow (SCFM)	Difference Compared to Control
1	Present Invention	930	644	1.74 %
2	Conventional one-piece grille and bell mouth unit	930	602	-4.88 %
3	Conventional separate-piece grille and bell mouth units	930	633	Control

The air flow performance of the air conditioner outdoor unit using the protective shield (10) of the present invention shows a general 1.74 % improvement compared to one using conventional separate grille and bell mouth units.

CLAIMS

1. A protective shield (10) for mounting on an air discharge port of an air conditioner outdoor unit having a fan comprising
 - 5 a frame (1) having an opening with a curved circumferential edge (2); and
 - a planar grille (3) having a plurality of curved ribs (4) arranged around the periphery (3B) of the grille (3), the ribs (4) extends from one side of the grille (3) to the curved circumferential edge (2) to form a generally V-shaped configuration, such that the grille (3) is entirely positioned at a level above the top surface of the frame (1).
- 10 2. A shield (10) according to claim 1 further comprising a bell mouth (5) having a straight portion (5A) and a curved portion (5B), wherein the bell mouth (5) is tangentially attached to the curved circumferential edge (2) at the straight portion (5A).
- 15 3. A shield (10) according to claim 2, wherein the bell mouth (5), the frame (1), and the grille (3) are formed integrally as a one-piece unit.
4. A shield (10) according to any of claim 2 or 3, wherein the ribs (4) are attached to the intersection between the curved circumferential edge (2) and the straight portion (5A) of the bell mouth (5).
- 20 5. A shield (10) according to any of claims 1-4, the ribs (4) and the circumferential edge (2) are curved in an opposite direction.
- 25 6. A shield (10) according to claim 5, wherein the ribs (4) are curved towards the centre (3A) of the grille (3) and the circumferential edge (2) is curved away from the centre (3A) of the grille (3).
7. A shield (10) according to any of claims 1-6, wherein the curvature radius of the ribs (4) is larger than the curvature radius of the circumferential edge (2).
- 30