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(54) **AIR DIFFUSER**

**Related U.S. Application Data**

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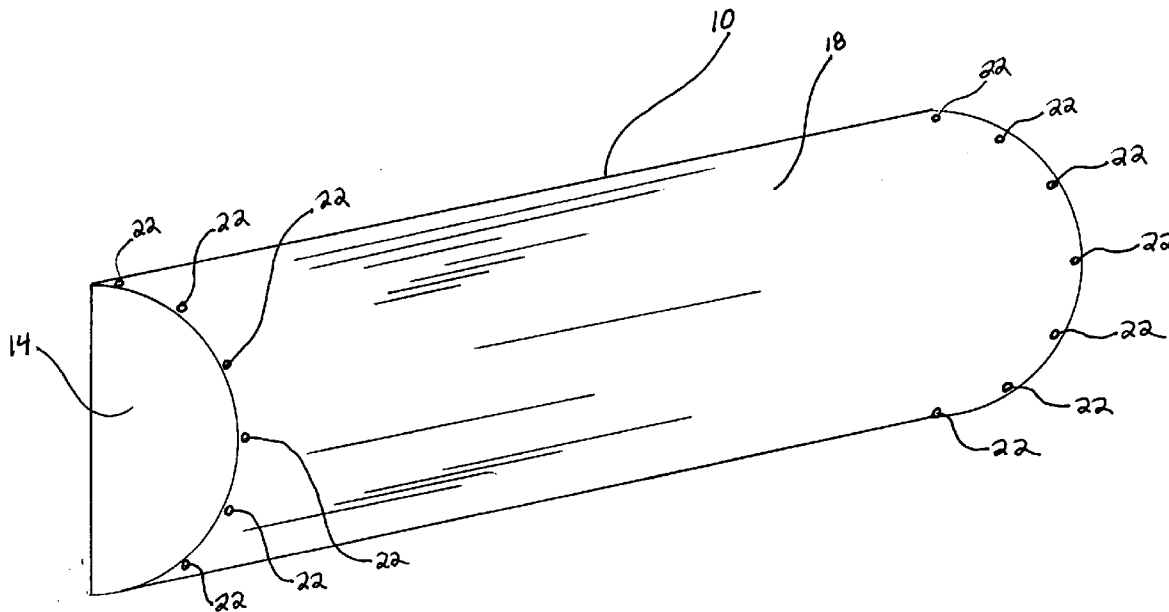
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(57) **ABSTRACT**

An improved air diffuser for shooting ranges and the like is both inexpensive, easy to transport, and easy to maintain. Flexible plastic is utilized for the diffuser plates providing easier manufacture and shipment of an unassembled diffuser.

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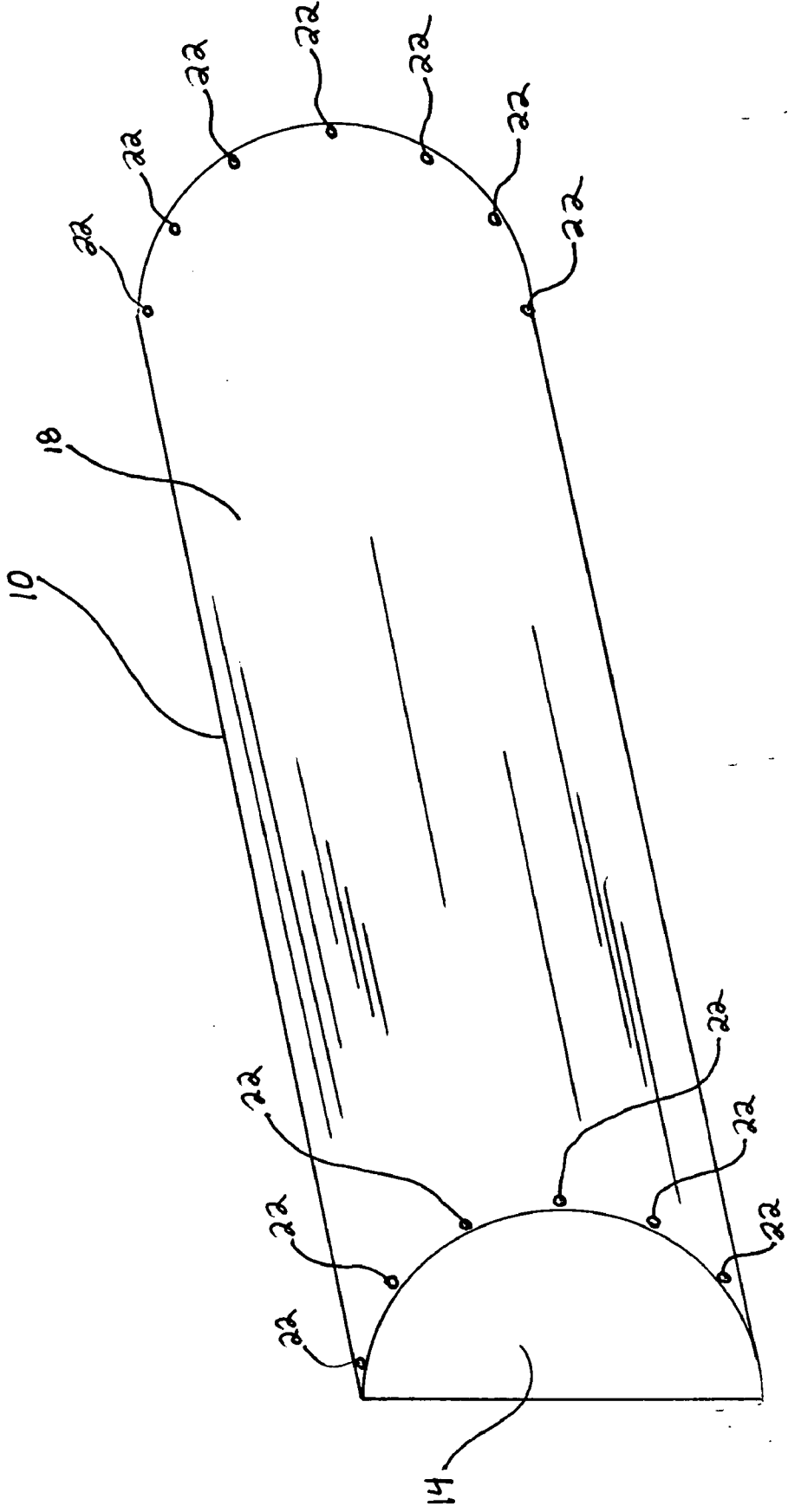


Fig. 1

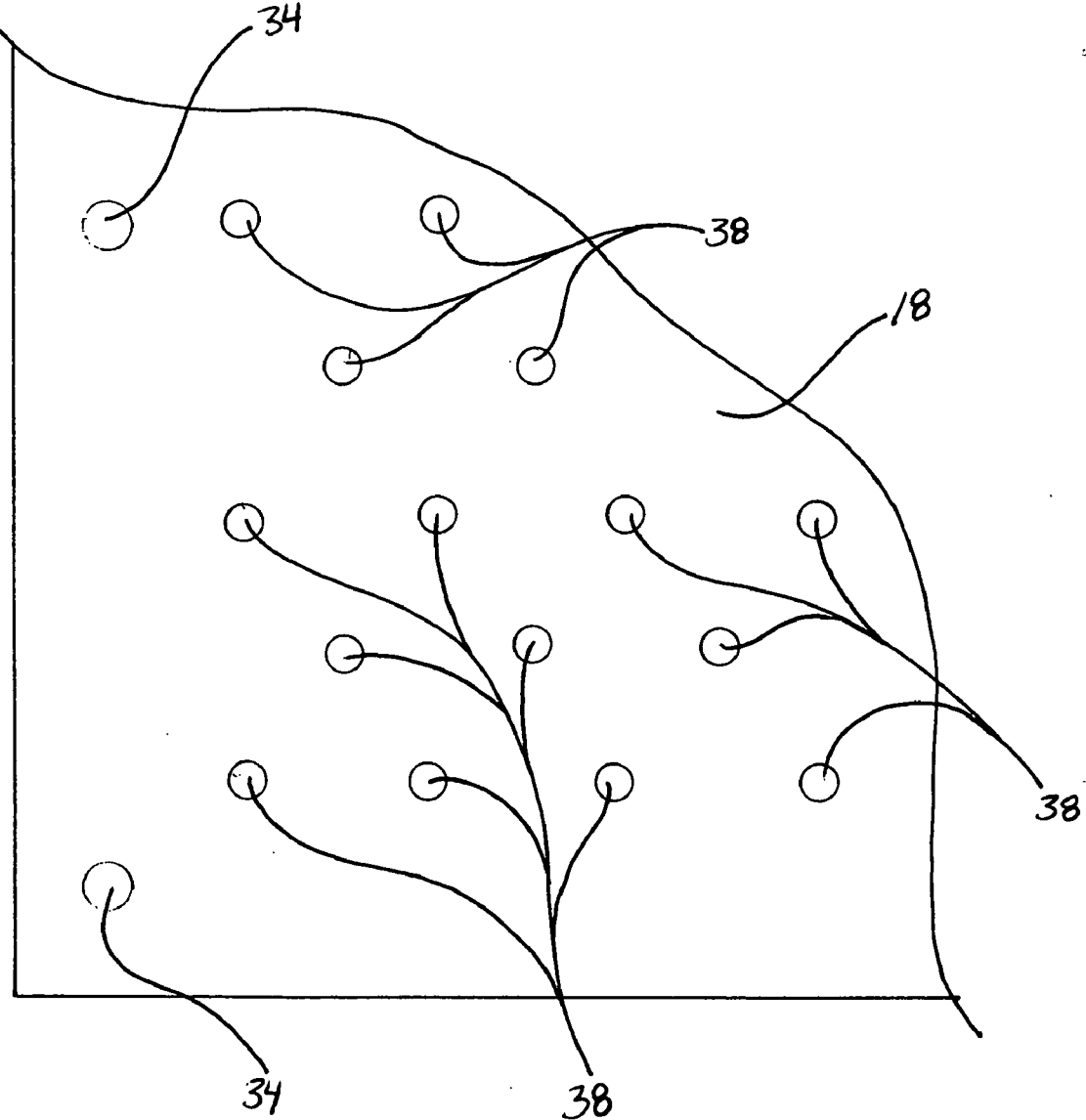


FIG. 2

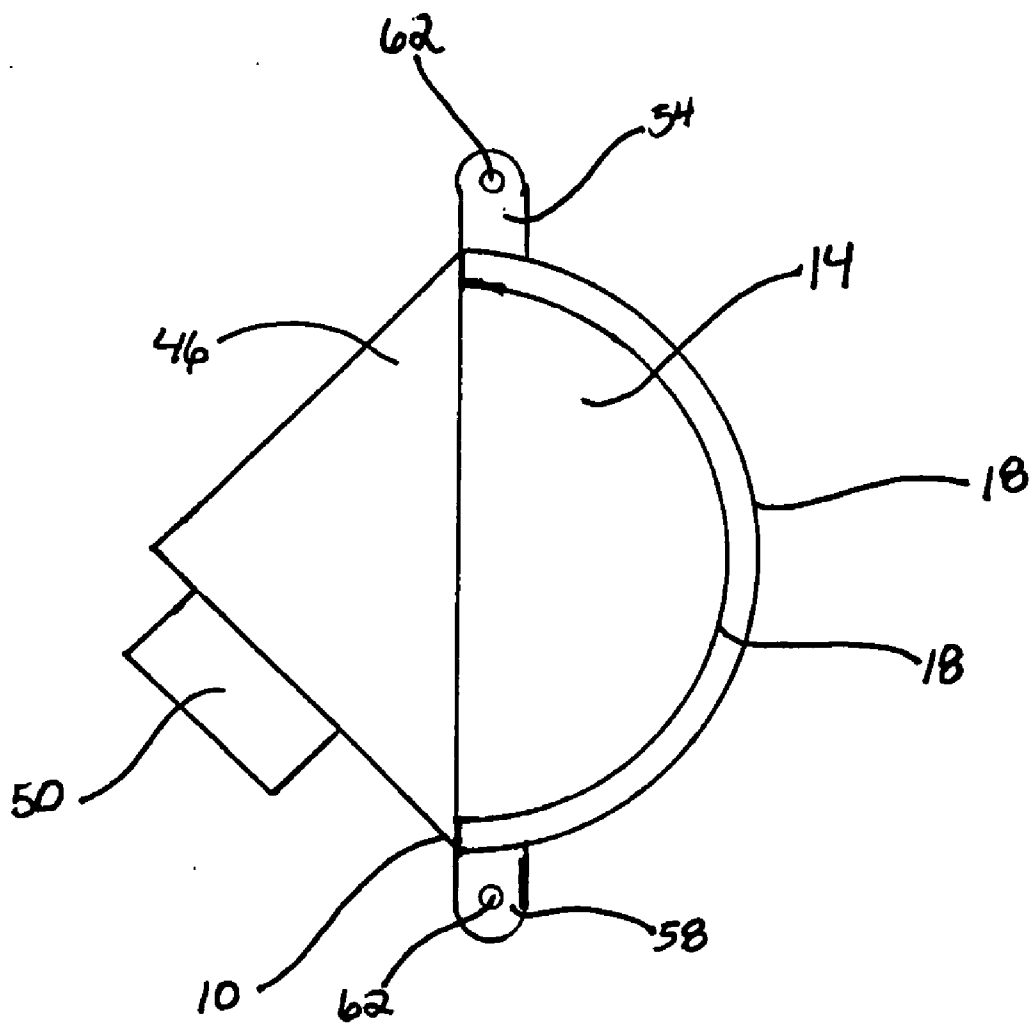


FIG. 3A

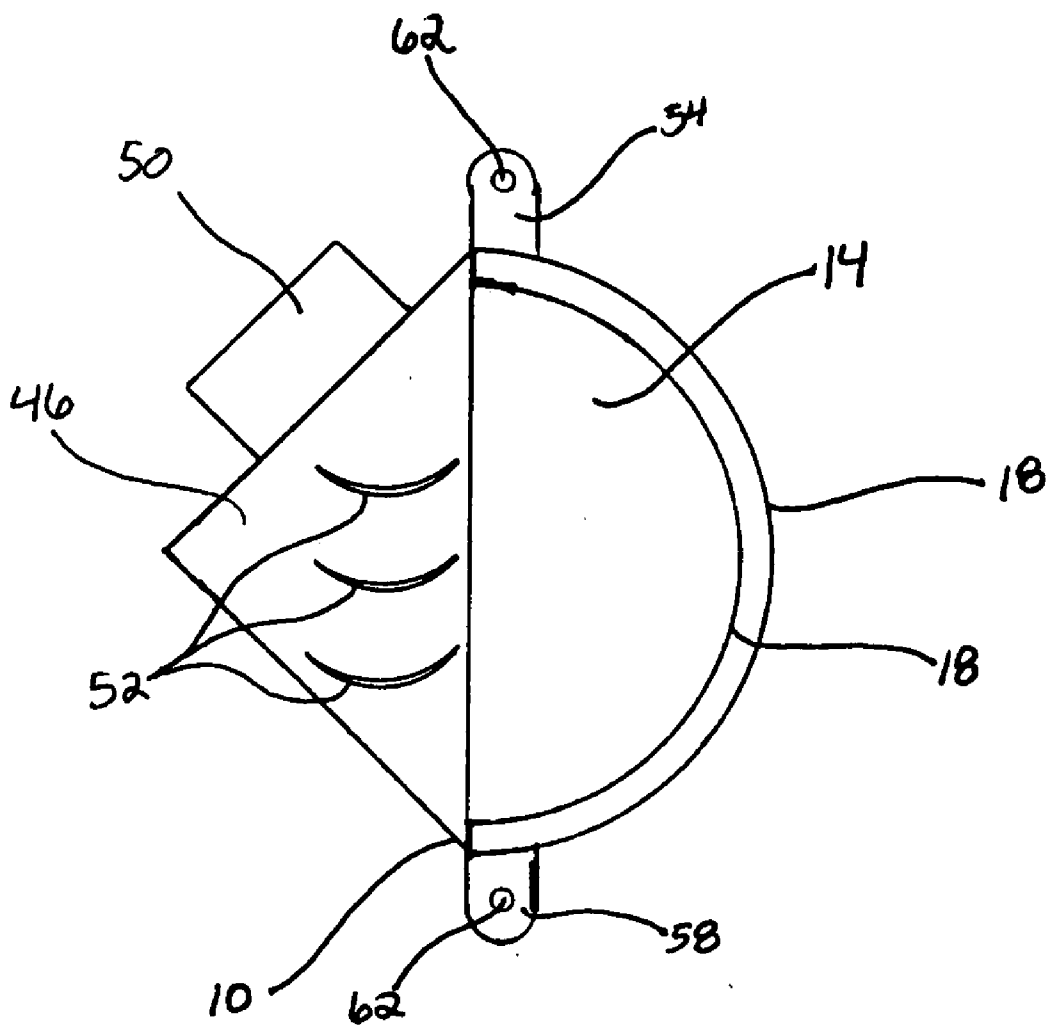


FIG. 3B

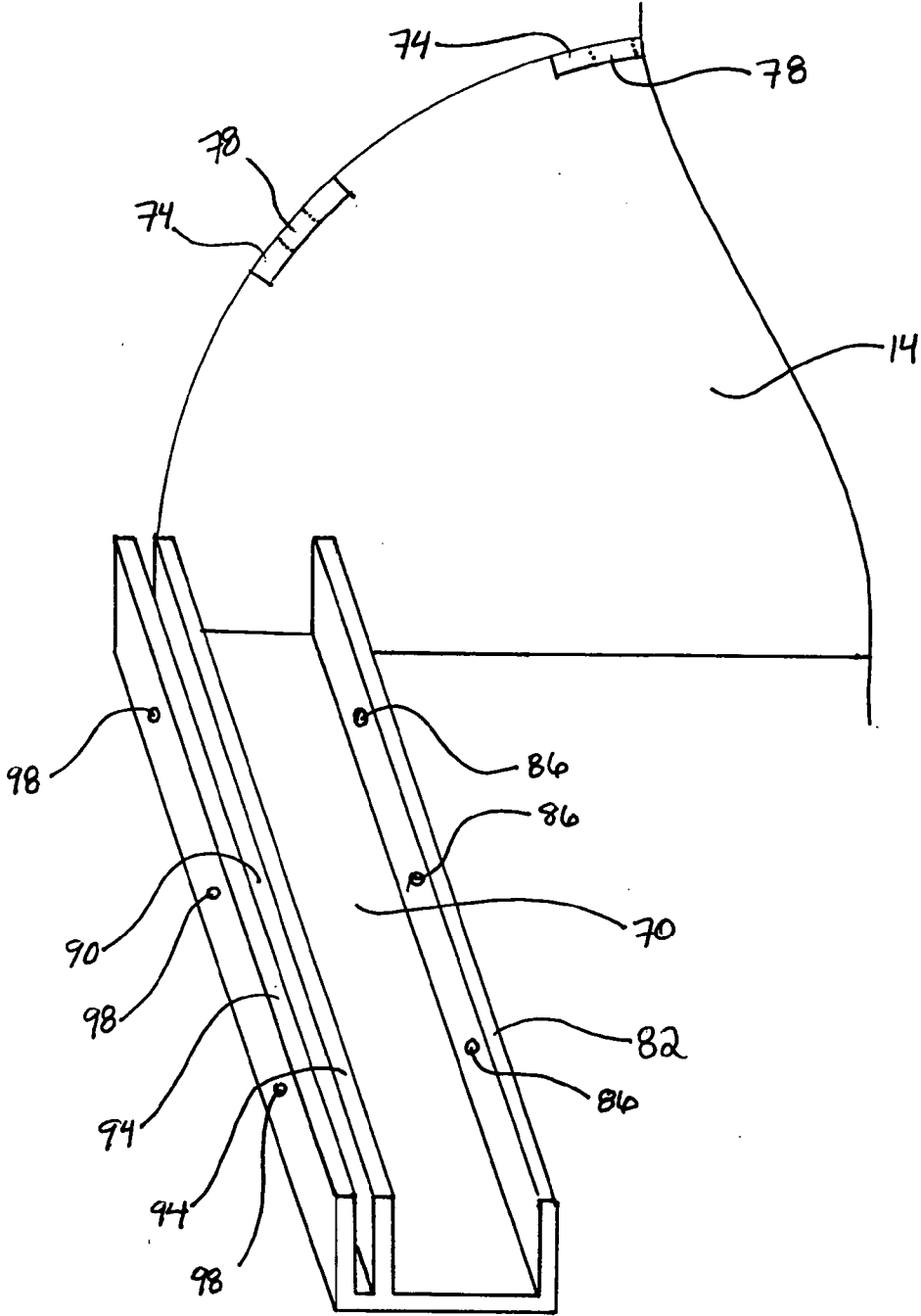


FIG. 4

## AIR DIFFUSER

### RELATED APPLICATIONS

[0001] The present application claims the benefit of U.S. Provisional Application Ser. No. 60/710,007, filed Aug. 19, 2005, which is incorporated herein in its entirety.

### BACKGROUND OF THE INVENTION

[0002] 1. The Field of the Invention

[0003] The present invention relates to an air diffuser. More specifically, the present invention relates to an improved air diffuser for use in shooting ranges and other environments.

[0004] 2. State of the Art

[0005] In shooting ranges and other areas where bullets are fired, it is desirable to control the movement of air. Specifically, it is desirable to create movement which draws smoke and air-born particles away from the shooter and, typically, down range.

[0006] In order to promote a uniform flow of air across all of the shooters and down the shooting range, diffusers have been utilized. A diffuser is an air box having an air inlet and a plurality of air outlets, and is designed to release air uniformly from the outlets, such that each outlet releases a similar amount of air as compared to the other air outlets. Thus, a diffuser which extends across the width of a shooting range and is disposed behind or above the shooters can release air evenly across the width of the shooting range. The even flow of the air is important because it prevents eddies or other turbulent current which might inhibit gasses and airborne particles from being carried down range with suitable air vents can be made downstream in the shooting range so that air flows from behind the shooters and down the shooting range, carrying smoke and particles away from the shooters.

[0007] Shooting range diffusers are typically formed from steel. The diffusers are formed with a steel air box which extends across the shooting range and is covered by parallel sheets of steel which have a plurality of small holes formed therein. When air is introduced into an inlet in the air box, the box becomes pressurized inside and air flows out of the holes formed in the sheets of steel to develop consistent airflow. These boxes are expensive as they require considerable labor to construct, and as steel is increasingly expensive. These air diffusers are also expensive to ship, as many of the parts for the diffuser are 3-dimensional in nature. Additionally, existing air diffusers can be somewhat difficult to clean and maintain, and can be damaged during shipping.

[0008] There is thus a need for an range air diffuser which is less expensive to produce and transport, and which is easier to maintain.

### SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide an air diffuser for shooting ranges and other environments which is less expensive and more convenient to use than existing diffusers.

[0010] According to one aspect of the present invention, a diffuser is provided which utilizes a plastic diffuser surface

instead of a metal surface. A plastic surface is less expensive than a metal surface as plastic is cheaper and easier to form than metal. Additionally, diffusers commonly have curved surfaces and a plastic diffuser front may be formed and shipped flat and bent as it is installed, making the diffuser easier to make and ship.

[0011] According to another aspect of the invention, a diffuser is provided which is easier to clean and maintain. A diffuser according to the present invention may be formed with hinges so as to allow a person to open the diffuser from the top and the bottom.

[0012] According to still another aspect of the present invention, the diffuser with plastic surfaces better prevents denting caused by impacts.

[0013] These and other aspects of the present invention are realized in an air diffuser as shown and described in the following figures and related description.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Various embodiments of the present invention are shown and described in reference to the numbered drawings wherein:

[0015] FIG. 1 shows a perspective view of a diffuser according to the present invention;

[0016] FIG. 2 shows a partial view of a diffuser plate of the diffuser of FIG. 1 and according to the present invention;

[0017] FIG. 3A shows an end view of the diffuser of FIG. 1 and according to the present invention;

[0018] FIG. 3B shows an alternate end view of the diffuser of FIG. 1 and according to the present invention; and

[0019] FIG. 4 shows a partial perspective view of a section of the diffuser of FIGS. 1-3B and according to the present invention.

[0020] It will be appreciated that the drawings are illustrative and not limiting of the scope of the invention which is defined by the appended claims. The various embodiments shown accomplish various aspects and objects of the invention.

### DETAILED DESCRIPTION

[0021] The drawings will now be discussed in reference to the numerals provided therein so as to enable one skilled in the art to practice the present invention. The drawings and descriptions are exemplary of various aspects of the invention and are not intended to narrow the scope of the appended claims.

[0022] Turning to FIG. 1, a perspective view of a diffuser according to the present invention is shown. The diffuser 10 is often formed into a semi-cylindrical shape as shown. Thus, semi-circular or arcuate side pieces 14, a back piece (not shown) and front plate 18 are used to form the diffuser 10. The front plate 18 is formed from a sheet of flexible plastic, and may be attached to the sides 14 with a plurality of fasteners 22, which may be bolts, screws, rivets, pop rivets, etc., with pop rivets being presently preferred. The flexible plastic is advantageous as a flat sheet may be easily bent around the curved sides 14 without pre-forming. Typically, air enters through the back or sides of the diffuser 10

and exits through uniform holes in the front plate **18**. The length and overall size of the diffuser may be adjusted to accommodate varying room sizes and air flow requirements.

[0023] Turning now to FIG. 2, a partial front view of a front plate according to the present invention is shown. The diffuser plate or front plate **18** is formed from a sheet of plastic as mentioned earlier. Many plastics are suitable. It is desirable that the plastic be flexible so as to easily bend around the sides **14**. It is also desirable that the plastic is not brittle, as this will allow for easier machining or forming of the plastic and will inhibit cracking of the plastic during use. Additionally, the plastic should be sufficiently rigid to maintain the desired shape. Suitable plastics include ABS, polyethylene, polypropylene, styrene, polystyrene, acetate, etc.

[0024] The front plate **18** is typically formed with attachment holes **34** whereby the front plate may be attached to the frame of the diffuser **10**. Additionally, the front plate **18** is formed with air holes **38** through which air exits the diffuser **10**. The holes **34**, **38** may be formed in many ways, including drilling, punching, molding, etc. In a diffuser **10**, air is pushed into the diffuser body by a blower or fan. The air holes **38** are sized such that the air inside of the diffuser **10** is pressurized by the blower or fan and a pressure drop is generated as air moves through air holes **38**. The pressure drop across the front plate **18**, and the corresponding increased pressure inside of the diffuser **10**, generates a fairly uniform flow out of the air holes **38**, such that a similar amount of air flows out of each air hole **38**. Thus, the number and size of air holes **38** is adjusted according to the size of the diffuser **10**, the amount of air moving through the diffuser, the size of the blower or fan, etc. Additionally, multiple diffuser plates **18** may be used such that the air passes through a first diffuser plate **18** and a second diffuser plate **18**.

[0025] Turning now to FIG. 3A, a sectional view of a diffuser according to the present invention is shown. The diffuser **10** is formed with a diffuser box **46**, side plate **14**, first diffuser plate **18**, second diffuser plate **18**, and an air inlet **50**. Air inlet **50** allows the diffuser **10** to be connected to an air source such as a blower or fan. The diffuser plates **18** are configured so as to provide uniform air flow out of the diffuser **10**. It will be appreciated that, depending on the circumstances in which the diffuser **10** is used, it may be advantageous to use different numbers of diffuser plates **18**. A single plate may be more efficient in some situations, while two or more diffuser plates **18** may be advantageous in other situations, as they provide more uniform flow. It may be that diffuser plates may be formed with a single size hole **38** (FIG. 2) and hole spacing, and that it is more convenient to use two diffuser plates **18** than to form diffuser plates with varying air hole **38** configurations. Thus, a machine such as a punch may be set up to form the diffuser plates and need not be readjusted for different sizes of diffusers **10**.

[0026] The diffuser **10** may also be formed with a top hinge **54** and a bottom hinge **58**. While a single top hinge **54** and single bottom hinge **58** are shown in this side view, it will be appreciated that a number or top hinges **54** and bottom hinges **58** may be used along the top and bottom edges of the diffuser **10**. The hinges are mounted to the diffuser such that the sides **14** and diffuser plates **18** may be pivoted away from the back **46**. The hinges **54**, **58** may be

arranged such that a top hinge **54** is used with a bottom catch, allowing the sides **14** and diffuser plates **18** to be released and pivoted upwards for cleaning or maintenance, or such that a bottom hinge **58** and top catch is used, allowing the sides **14** and diffuser plates **18** to be pivoted downwardly.

[0027] According to one aspect of the present invention, top and bottom hinges **54**, **58** may be used, and formed such that the hinge pin **62** may be removed from the hinge **54**, **58** allowing the hinge to separate. Thus, any or all of the top and bottom hinges **54**, **58** may be released. Releasing the bottom hinge **58** allows the sides **14** and diffuser plates **18** to be pivoted upwardly. Releasing the top hinge **54** allows the sides **14** and diffuser plates **18** to be pivoted downwardly. Releasing both of the hinges **54**, **58** allows the sides **14** and diffuser plates **18** to be removed completely. The hinges **54**, **58** may be plates with holes formed therein, and having a pin or bolt passed through the holes to form a hinge. The hinges **54**, **58** may also be formed from tubes with hinge pins placed inside of the tubes. Many types of hinges, including releasable hinges, are suitable.

[0028] Turning now to FIG. 3B, an alternate end view of the diffuser of the present invention is shown. The diffuser is the same as that of FIG. 3A and is numbered accordingly. As such, the differences will be highlighted herein. The air inlet **50** of the diffuser **10** is mounted to the upper surface of the back **46**. The diffuser **10** also includes one or more baffles **52**. The baffles **52** aid in directing airflow from the inlet **50** to the diffuser plates **18**, and air in providing a more even air flow from the diffuser. The baffles **52** may be curved as shown, or may be straight.

[0029] Turning now to FIG. 4, a partial perspective view of a side and a connecting rail of a diffuser according to the present invention is shown. A connecting rail **70** is attached to the side **14** so as to provide a stronger structure to receive the diffuser plates **18** and to provide mounting surfaces to attach the diffuser plates **18**. The side **14** is shown with brackets **74** which may easily be formed by bending a tab so as to be perpendicular to the side **14**. The brackets **74** are shown with holes **78** which correspond with holes **34** of FIG. 2 and which allow the diffuser plate **18** to be attached to the side plate **14** with bolts, screws, rivets, etc.

[0030] The edge of a diffuser plate **18** may be attached to the connecting rail **70** to further strengthen the diffuser **10** and to seal air leaks. Accordingly, the connecting rail **70** may have a flange **82** configured to receive a diffuser plate **18**. The flange **82** may typically be formed with holes **86** whereby the diffuser plate **18** may be attached. Flange **82** provides a location whereby an inner diffuser plate **18** may be attached. Thus, it will be appreciated that the connecting rails **70** and other parts of the diffuser may easily be designed to accommodate varying numbers and sizes of diffuser plates **18**.

[0031] A channel **90** may also be formed whereby an edge of a diffuser plate **18** may be inserted. The channel **90** may be formed between two flanges **94**. The channel **90** may be designed such that once a diffuser plate is attached to brackets **74**, no attachment is necessary to secure the diffuser plate **18** into the channel **90** and to prevent excessive air leakage around the edge of the diffuser plate **18**. Alternatively, holes **98** may be formed through the flanges **94** so as to permit fastening of the diffuser plate **18**. A simple single



flange, such as one of flange 94, may be used in place of a channel. It will be appreciated that internal bracing may be used to strengthen the diffuser, such as corner braces or diagonal braces extending between connecting rail 70 and side 14 as may be necessary for a particular size or design of diffuser.

[0032] It will be appreciated that a diffuser according to the present invention may be made in varying sizes according to the needs of a particular use. It will also be appreciated that a diffuser according to the present invention may be significantly less expensive than conventional shooting range diffusers. Conventional diffusers have been made from steel in order to provide a diffuser which is strong enough to withstand the abuse of a shooting range. Steel is expensive, and is more difficult to machine. Thus, available diffusers are somewhat expensive. Applicant has found that plastic diffuser plates are strong enough for a shooting range, and may even be more durable as they do not dent as a metal plate would when accidentally bumped. Applicant has also found that a diffuser with plastic diffusion plates is less expensive to ship, as the diffuser may be shipped unassembled, and all of the pieces are relatively flat. Existing diffusers have a steel diffusion plate which must be bent to the desired shape before shipping and assembly, requiring a larger object be shipped at additional cost. If a replacement diffuser plate is required, a replacement plate may be shipped flat to the customer. The diffuser plates are easily bent into the desired shape as they are installed.

[0033] In all, the cost of the diffuser can be reduced by more than 80 percent while providing comparable performance. Additionally, the diffuser of the present invention can be readily cut down to size in the event measurements were not accurate. With a conventional steel diffuser, a new diffuser would have to be ordered.

[0034] A diffuser according to the present invention is easier to service than existing diffusers. Existing diffusers may be sealed, or may have a piano hinge on the top of the diffuser. Shooting range operators have found existing diffuser designs difficult to clean and maintain. As previously discussed, applicant's design involving top and bottom releasable hinges allows easy access to the diffuser for cleaning and maintenance.

[0035] Applicant has also found that the plastic diffuser plates provide another unique advantage. The diffuser plates can act as an air filter. As most plastics do not conduct electricity or effectively diffuse electrical charge, the constant air flow through the plastic diffuser plates creates an electrostatic charge on the plates. The electrostatic charge on the diffuser plates attracts dust particles from the air. The additional filtration provides an important benefit in a shooting range, where dust particles in the air may commonly include smoke or even metal particles such as from the lead bullets which are not desirable to inhale.

[0036] There is thus disclosed an improved air diffuser. It will be appreciated that numerous changes may be made to the present invention without departing from the scope of the claims.

What is claimed is:

1. An air diffuser configured for use in a ballistic environment comprising:

- a back;
  - a first side disposed at a first end of the back and a second side disposed at a second end of the back;
  - an air inlet; and
  - an air diffuser plate, the diffuser plate being formed from plastic and being attached to the diffuser such that air exiting the diffuser flows through the plate.
2. The diffuser of claim 1, wherein the diffuser plate has a plurality of air exit holes formed therein.
  3. The diffuser of claim 1, wherein the diffuser plate is bent into a curved shape.
  4. The diffuser of claim 1, further comprising a releasable top hinge and a releasable bottom hinge, the hinges configured such that the bottom hinge may be released to pivot the diffuser plate upwardly and such that the top hinge may be released to pivot the diffuser plate downwardly.
  5. The diffuser of claim 1, wherein the diffuser comprises two diffuser plates.
  6. A method for purifying air in a ballistic environment comprising:
    - selecting a diffuser, the diffuser having a cavity, a first opening, and a second opening;
    - placing a diffuser plate over the first opening, the diffuser plate being formed of non-electrically conductive plastic and having a plurality of air exit holes formed therein;
    - connecting the second opening to an air source; and
    - operating the air source such that air is moved into the cavity and through the air exit holes and such that a static charge is formed on the diffuser plate.
  7. The method of claim 6, wherein the static charge attracts dust particles to the diffuser plate.
  8. The method of claim 6, wherein the diffuser plate is curved when mounted to the diffuser.
  9. The method of claim 6, wherein the method further comprises opening the diffuser for cleaning by rotating the diffuser plate, the diffuser plate being releasably attached to the diffuser such that the diffuser plate may be pivoted upwardly relative to the diffuser, pivot downwardly relative to the diffuser, or removed from the diffuser.
  10. A method for forming a diffuser plate, the method comprising:
    - selecting a first end piece and a second end piece, each end piece having an arcuate surface;
    - bending a resilient diffuser plate having a plurality of holes formed therein over the arcuate surfaces; and
    - attaching the resilient diffuser plate to the arcuate surfaces.
  11. The method according to claim 10, wherein the method comprises attaching the resilient diffuser plate to the arcuate surfaces with rivets.
  12. The method according to claim 10, wherein the resilient diffuser plate is formed from plastic.
  13. The method according to claim 10, wherein the method comprises attaching a second resilient diffuser plate to the diffuser such that the second resilient diffuser plate is generally parallel to the first resilient diffuser plate.

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