SEARCH ROOM

Dec. 27, 1949 W. W. KENNEDY 2,492,294

AIR ENTRANCE GRID

Filed April 8, 1947 2 Sheets-Sheet 1

Fig. 1.

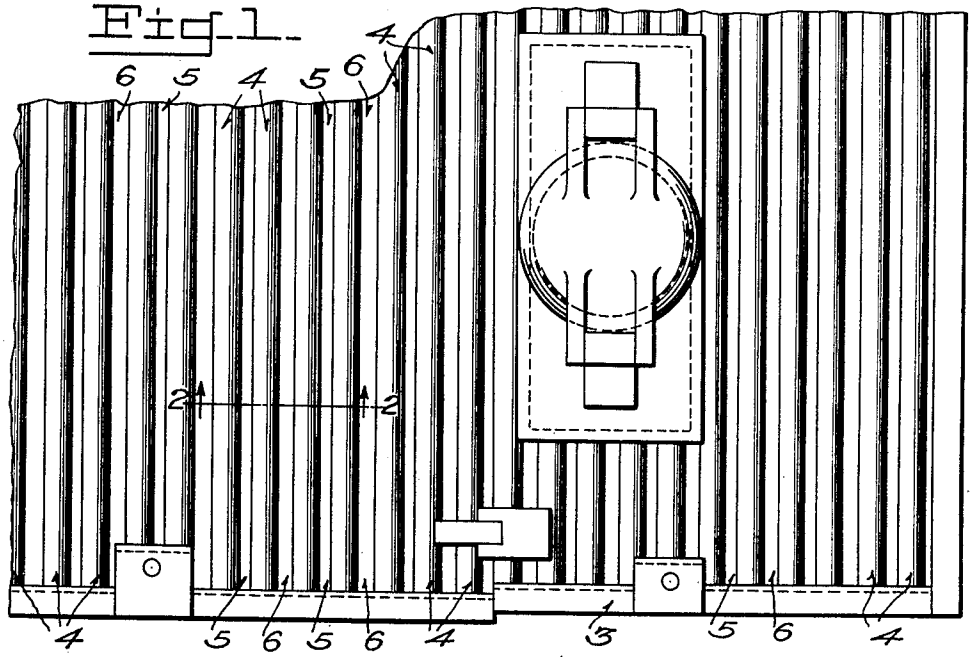


Fig. 2.

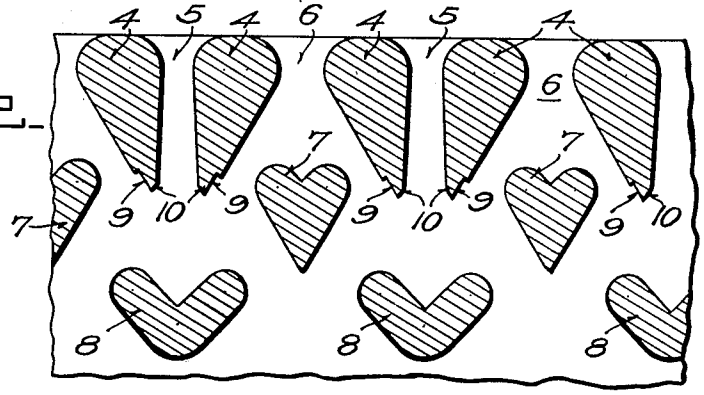
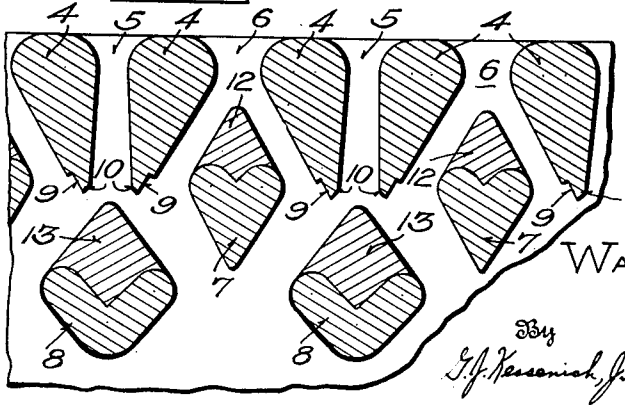


Fig. 3.



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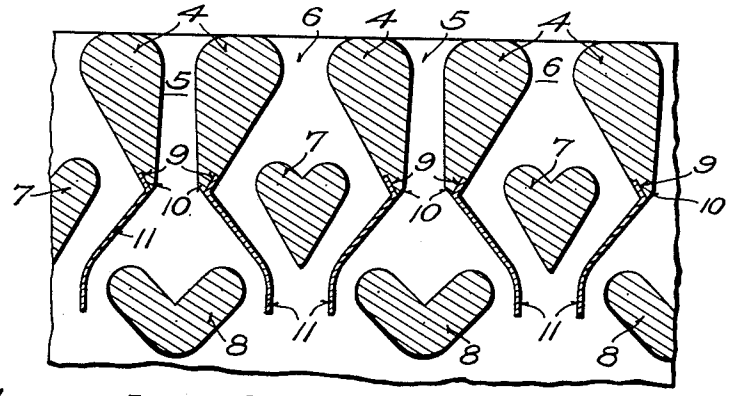
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Fig. 4.



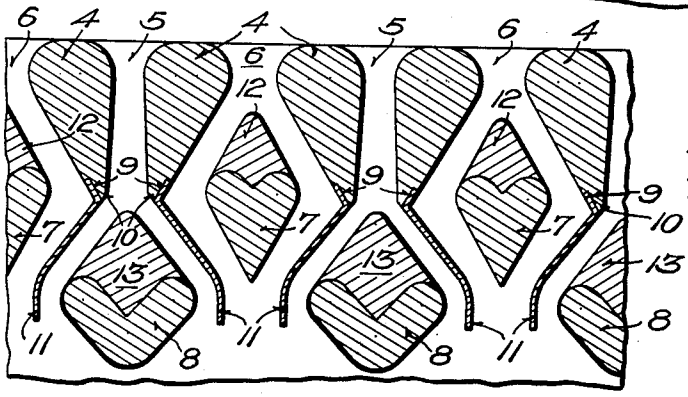


Fig. 5.

Fig. 6.

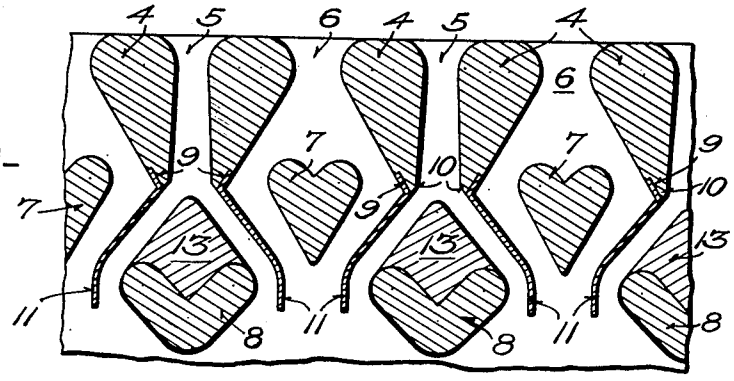
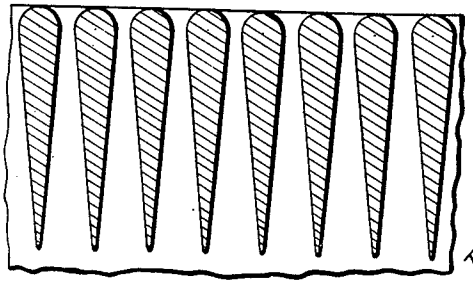


Fig. 7.



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AIR ENTRANCE GRID

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10 Claims. (Cl. 109—85)

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This invention relates to an improved bullet and spatter proof air entrance grid which may be used to cover the ventilation opening of an armored structure, for example the engine door of a tank. Such a ventilation opening may be vertical as in the side, horizontal as in the top, or inclined through any point in the surface in an armored structure, and it is extremely important that the opening provide adequate ventilation in permitting a high rate of air flow therethrough. It is further extremely important that such a ventilation opening be provided with protection when exposed to fire from bullets and bullet spatter.

In Patent No. 2,392,215, issued January 1, 1946, jointly to Victor R. Abrams and myself, there is disclosed a bulletproof grid for an opening in an armored structure, which is designed to dissipate the force of a bullet or its spatter without permitting entrance thereof into the enclosure, the grid comprising an open frame member having a series of spaced parallel bars, each bar having an outwardly facing concave surface and a pair of inwardly converging lateral faces. These bars are substantially of heart shape design, in cross section, and for the sake of simplicity will be hereinafter referred to as heart shape bars. The grid containing these bars as disclosed in the patent has excellent ballistic characteristics and provides the desired protection.

As above pointed out it is also extremely important that the opening in the armored structure provide adequate ventilation in permitting a high rate of air flow therethrough. Excellent ventilation with the desired high rate of air flow could be realized with a grid having therein but one row of spaced parallel bars, each of standard airfoil or tear drop design in cross section, due to the resultant Venturi effect, the air entrance shock losses and leaving edge turbulence loss being thus kept very low. Such a grid, however. would obviously have very poor ballistic characteristics, providing very poor protection from bullets and their spatter.

It is therefore an object of this invention to provide an improved air entrance grid having excellent ballistic characteristics to afford the desired protection and also having the desired aerodynamical characteristics to afford a high rate of air flow therethrough.

Another object of this invention is to provide an improved air entrance grid which, while retaining substantially the same excellent ballistic characteristics and protection against bullets and bullet spatter as the above grid containing only heart shape bars, will permit a greatly increased air flow thereover for a given pressure drop.

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Another object of this invention is to provide an improved air entrance grid having desired aerodynamical characteristics permitting a high rate of air flow at least approaching or even exceeding that of a grid containing only spaced parallel bars of standard airfoil or tear drop design, while at the same time having greatly increased and desirable ballistic characteristics thereover thus affording excellent protection from bullets and bullet spatter.

These and other objects as will be apparent from the following description are accomplished by means of particular configuration and arrangement of the bars in the grid frame. In general, this particular configuration and arrangement of the bars includes a first or outer series of parallel bars which, as shown in Figures 2 to 6 of the drawing and as hereinafter described, are of slightly modified, but in general having a substantially standard, tear drop or airfoil design in cross section in that each of these bars has a generally convex outward face and a pair of inwardly generally converging lateral faces. These bars of this first or outer series are arranged in pairs such that the laterally adjacent opposing faces of the bars of each pair which form an air passage are substantially parallel, but may be slightly diverging, forming a Venturi-like passage, while the other lateral face of a bar of each pair is opposite a similar face of a bar of an adjacent pair, forming an inwardly greatly divergent air passage. Displaced inwardly from the outer edge of the first or outer row of bars is a series of parallel bars each having inwardly converging lateral faces and being of general heart shape design in cross section and which may have streamline means provided thereon as hereinafter described by the addition of a header to the outward face, each of these bars being disposed at least partly within each divergent air passage between adjacent pairs of outer bars and in effect inwardly bisecting each divergent air passage. Also disposed inwardly from the outer series of bars is a series of parallel bars each having inwardly converging lateral faces and being heart shape design in cross section which may have streamline means provided thereon by the addition of a header to the outward face as hereinafter described, each of these bars being disposed inwardly of and opposite one of the air passages formed by the inside adjacent opposing faces of the bars of each of the pairs of outer bars. Each series of bars is parallel lying between two parallel surfaces. Thus, the surface containing the outer edges of the bars of each series is parallel to a surface passed through corresponding points of

the respective bars or to a surface containing the inner edges.

An illustration of the invention is disclosed in the following description and drawing in which:

Figure 1 is a plan view of an air entrance grid embodying my invention as applied to the horizontal ventilation opening in the top of a combat tank.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a section similar to Figure 2, but showing a streamline modification of the inwardly displaced bars.

Figure 4 is a section similar to Figure 2, but showing the addition of turning vanes on the inner ends of the outer bars.

Figure 5 is a section similar to Figure 2, but embodying the features of both Figures 3 and 4.

Figure 6 is a section similar to Figure 2, embodying the features of both Figures 3 and 4, but in which only one series of the inwardly displaced bars is streamline modified.

Figure 7 is a section of an air entrance grid illustrating bars of standard airfoil or tear drop design.

Figure 1 indicates a portion of my air entrance grid disposed horizontally in an armored structure, hinged as in the top of a combat tank. Mounted in an opening in the structure is a frame 3 of an air entrance grid, which may comprise the engine door of the tank, designed to admit ventilating air and containing spaced parallel bars to provide protection from bullets and bullet spatter. As above indicated, this invention consists of the particular configuration and arrangement of the bars in the grid frame.

A first or outer series of parallel bars 4 suitably of steel are of slightly modified airfoil or tear drop design in cross section, in general substantially corresponding to the standard airfoil or tear drop design cross section illustrated in Figure 7. Bars 4 are arranged in pairs, as shown in Figures 2 to 6, such that wide laterally adjacent interiorly opposing faces of the bars of each pair are substantially parallel or but slightly inwardly divergent, forming an air entrance passage 5 therebetween. The remaining wide exterior lateral face of each bar 4 of one pair is opposite a similar face of a bar of an adjacent pair, thus forming an inwardly greatly divergent air passage 6 between each pair of bars 4.

Displaced inwardly from the outer edge of the outer series of parallel bars 4 is a second series of parallel bars 7, each of which is disposed directly inward of one of the divergent air passages 6 formed between the adjacent pairs of outer bars 4. Bars 7 have inwardly converging lateral faces. Displaced inwardly from the inner ends of bars 4 is a third series of parallel bars 8, each of which is disposed directly inward of one of the air passages 5 formed between each pair of bars 4. Bars 8 are displaced inwardly a greater distance than bars 7. Similar to bars 7, bars 8 have inwardly converging lateral faces.

The lateral faces of bars 4 at their converging inward edges have indentations or cut-away portions 9 and 10 as shown in Figure 2, in order to secure integrally thereto as by welding, the turning vanes 11 if desired, and as shown in Figures 4, 5 and 6, providing a substantially increased rate of air flow. Turning vanes 11 are of sheet metal and form as shown a widely divergent extension of each air passage 5 in which extension is one of bars 8 so located centrally that there is

an ample air passage on each side of the latter. Turning vanes 11 further serve to confine the flow of air through greatly divergent air passage 6 between adjacent pairs of outer bars 4 to a passage inwardly on each side of second series bars 7.

As above pointed out, the inwardly displaced bars 7 and 8 constituting the respective second and third series of parallel bars have inwardly converging lateral faces. In order to provide protection from bullets and bullet spatter, each of bars 7 and 8 has an outwardly facing concave surface, broadly, which may be either curved or dihedral, forming a pocket facing outwardly in the nature of a concave surface, merging at its outward extremities into the inwardly converging lateral faces. Bars 7 and 8 are suitably of armor steel. In order to increase the rate of air flow, bars 7 or bars 8, or both bars 7 and 8, may have streamline means provided thereon as above pointed out, if desired. As shown in Figures 3, 5 and 6, such provision on the bars 7 is accomplished by securing in suitable manner to the outer surface of the outwardly facing concave surface or pocket of each of bars 7 a header 12 of wood or suitable plastic material, having outwardly converging lateral faces. In similar manner, such provision on each of bars 8 is accomplished by suitably securing thereto a header 13 of wood or suitable plastic material having outwardly converging lateral faces. This provision of streamline means on bars 7 and/or 8 in this manner results in increased air flow by elimination of the obstruction to flow inherent in the outwardly facing concave surfaces or pockets of bars 7 and 8, and by the use of wood or suitable plastic material for the headers in accomplishing this streamlining the desirable bullet and spatter protection afforded by the outwardly facing pockets or concave surfaces of the steel bars is retained.

Illustrative of the greatly increased rate of air flow through air entrance grids embodying my invention, the following table shows the comparative results of actual air flow tests under the same conditions with various air entrance grids, in which the figures represent cubic feet of air per minute expressed as a percent, on normal air flow through the grids:

	Type of Grid	Percent
1	Figure 7, Standard Airfoil	100.0
2	All heart shape bars, 3 series, as in Patent No. 2,392,215	61.2
3	Figure 2	78.7
4	Figure 3	87.2
5	Figure 4	94.4
6	Figure 6	98.3
7	Figure 5	105.3

Actual air flow tests under the same conditions for reverse flow resulted in percentage figures comparable with those above for normal air flow.

It will thus be seen that by embodying the air entrance grids of my invention, while retaining substantially the same desirable bullet and spatter protection afforded by the air entrance grid employing only three rows or series of substantially heart shape bars, as disclosed in Patent No. 2,392,215, a greatly increased rate of air flow thereover is realized, providing effective and efficient ventilation.

Specific embodiments of my invention have been shown and described, but it will be understood that various modifications may be made without

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departing from the spirit or scope of my invention as set forth in the following claims.

What I claim is:

1. An air entrance grid comprising an open frame member having secured therein a series of spaced parallel outer bars, each being of substantially tear drop design in cross section and having a generally convex outward face and inwardly generally converging lateral faces, said outer bars being arranged in pairs, the bars of each of said pairs being arranged in an opposite configuration to provide a Venturi-like air passage between adjacent lateral faces of the bars of each of said pairs and an inwardly divergent air passage between each of said pairs, and additional parallel bars displaced inwardly with respect to said first series, each of said additional bars including an outer pocket surface and a pair of inwardly converging lateral surfaces, said additional bars being secured in said frame member directly inward of said Venturi-like and inwardly divergent air passages.

2. An air entrance grid comprising an open frame member, a first series of spaced parallel outer bars, each of substantially airfoil design in cross section with a generally convex outward face and inwardly generally converging lateral faces, said outer bars being secured in said frame member, said outer bars being arranged in pairs, the bars of each of said pairs being arranged in a relatively opposite configuration to provide a Venturi-like air passage between adjacent lateral faces of the bars of each of said pairs and an inwardly divergent air passage between each of said pairs, a second series of spaced parallel bars displaced inwardly of said first series and secured in said frame member directly inward of said divergent air passages, and a third series of spaced parallel bars displaced inwardly of said first series and secured in said frame member directly inward of said Venturi-like air passages, each of the bars of said second and third series having a substantially concave outward protective surface and a pair of inwardly converging lateral surfaces.

3. An air entrance grid comprising an open frame member, a series of spaced parallel outer bars, each of substantially airfoil design in cross section with a generally convex outward face and inwardly generally converging lateral faces, said outer bars being secured to said frame member, said outer bars being arranged in pairs to provide an inwardly divergent air passage between each of said pairs and a Venturi-like air passage between adjacent lateral faces of the bars of each of said pairs, a turning vane secured to the inner edge of each of said outer bars, said turning vanes on each pair of outer bars providing an inwardly divergent extension of said Venturi-like air passage, a series of spaced parallel bars having outer pocket surfaces and inwardly converging lateral surfaces displaced inwardly of said outer bars and secured to said frame member within said inwardly divergent extension between said turning vanes, and a series of spaced parallel bars having outer pocket surfaces and inwardly converging lateral surfaces displaced inwardly of said outer bars and secured in said frame member directly inward of said divergent air passages.

4. An air entrance grid comprising an open frame member, a series of spaced parallel outer bars in said frame member, each of substantially airfoil design in cross section with an outward substantially convex surface, said outer bars being arranged in pairs to provide an inward air passage between the bars of each of said pairs and inwardly widely divergent air passages between adjacent pairs, additional spaced parallel bars displaced inwardly from said outer bars and secured in said frame member directly inward of said air passages, each of said additional bars having an outward concave-like protective surface and a pair of inwardly converging lateral surfaces, and a header having outwardly converging lateral surfaces secured at its inward surface to said outward concave-like surface of each of a plurality of said additional bars to provide streamline means thereon while retaining protection afforded by said outward concave-like surfaces.

5. An air entrance grid comprising an open frame member, a series of spaced parallel outer bars, each of substantially airfoil design in cross section with an outward generally convex face, said outer bars being secured and arranged in said frame member in pairs to provide a widely inwardly divergent air passage between each adjacent pair and also a slightly inwardly divergent Venturi-like air passage between opposing lateral faces of the bars of each of said pairs, a second series of spaced parallel bars displaced inwardly of said outer bars and secured in said frame member directly inward of said widely divergent air passages, a third series of spaced parallel bars displaced inwardly of said outer bars and secured in said frame member directly inward of said Venturi-like air passages, each of the bars of said second and third series having a protective substantially concave pocket-like outward face and a pair of inwardly converging lateral faces, streamline headers, each of said headers presenting a pair of outwardly converging lateral faces, said headers being secured at their inward faces to said inwardly displaced bars at said pocket-like outward faces thereof, thereby providing for streamline air flow while retaining protection afforded by said pocket-like outward faces, and a turning vane secured to the inner edge of each of said outer bars, said turning vane on each outer bar of each pair being of opposite configuration to provide an inwardly divergent extension of said Venturi-like air passages.

6. An air entrance grid comprising an open frame member, a series of spaced parallel outer bars, each of substantially airfoil design in cross section and having a generally convex outward surface and inwardly generally converging lateral surfaces, said outer bars being secured in said frame member and arranged in pairs, the bars of each of said pairs being arranged in an opposite configuration to provide a widely inwardly divergent air passage between each adjacent pair and also a slightly inwardly divergent Venturi-like air passage between the opposing lateral faces of the bars of each of said pairs, turning vanes secured to each of said outer bars at the inward edge thereof, said turning vanes being of opposite configuration with respect to the bars of each of said pairs to provide an inwardly divergent extension of said Venturi-like air passage, additional bars displaced inwardly of said outer bars and axially parallel thereto, one of said additional bars being secured in said frame member directly inward of each said inwardly divergent extension between said turning vanes, and one of said additional bars being secured in said frame member directly inward of each said widely divergent air passage, each of said additional bars being of substantially heart shape design with an outward protective concave surface and a pair

of inwardly converging lateral surfaces, and streamline means secured to each of a plurality of said additional bars at the outward concave surface thereof, said means comprising a pair of outwardly converging lateral surfaces, thereby providing for streamline air flow while retaining the protection afforded by said outward concave surface.

7. In a bullet-proof grid air entrance grid comprising an open frame member with inwardly displaced spaced parallel protective grid bars of outwardly divergent design secured therein, a series of spaced parallel outer bars, each of substantially airfoil design in cross section and having an outward generally convex face and inwardly generally converging lateral faces, said outer bars being secured in said frame member and arranged in pairs, the bars of each of said pairs being arranged in an opposite configuration to provide a widely inwardly divergent air passage between each adjacent pair and also a Venturi-like air passage between the opposing lateral faces of the bars of each of said pairs.

8. In a bullet-proof air entrance grid comprising an open frame member with inwardly displaced grid bars of outwardly divergent protective design secured therein, a series of spaced parallel outer bars, each of substantially airfoil design in cross section and having an outward generally convex face and inwardly generally converging lateral faces, said outer bars being secured in said frame member and arranged in pairs to provide an air passage between opposing lateral faces of the bars of each of said pairs and passages between adjacent pairs, and turning vanes secured to the inward edges of said outer bars, said turning vanes with respect to the bars of each of said pairs of outer bars being of opposite configuration to provide an inwardly divergent extension of said air passage between the bars of each of said pairs.

9. In a bullet-proof air entrance grid comprising an open frame member having secured therein

spaced parallel grid bars of a protective design embodying outward substantially concave protective surfaces and inwardly converging lateral surfaces, streamline air flow means on said bars consisting of headers secured on said bars at their outward concave surfaces and having outwardly converging lateral faces blending inwardly with said inwardly converging lateral surfaces of said bars, thereby providing for streamline air flow while retaining bullet protection afforded by said outward concave surfaces.

10. In an armored structure, a bullet-proof air entrance grid comprising an open frame member with inwardly displaced spaced parallel protective grid bars of outwardly divergent protective design secured therein, a series of spaced parallel outer bars, each of said outer bars being of substantially airfoil design in cross section with an outward generally convex face and inwardly generally converging lateral faces, said outer bars being secured in said frame member and arranged in pairs, the bars of each of said pairs being arranged in an opposite configuration to provide a widely inwardly divergent air passage between each adjacent pair and also a Venturi-like air passage between the opposing lateral faces of the bars of each of said pairs.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,865,677	Cheyney	July 5, 1932
2,376,331	Abrams	May 22, 1945
2,392,215	Abrams et al.	Jan. 1, 1946

FOREIGN PATENTS

Number	Country	Date
492,085	France	Mar. 4, 1919