Feb. 20, 1934. A. H. BENESH 1,947,752

FLUID PROJECTOR

Filed Feb. 3, 1930 3 Sheets-Sheet 1

Fig. 1.

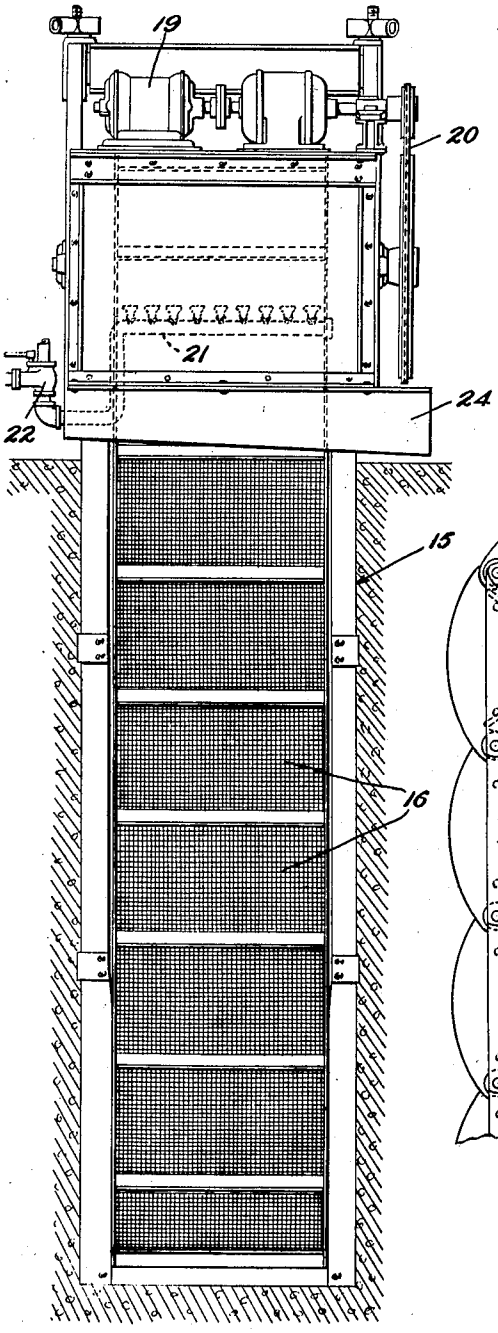

Fig. 2.

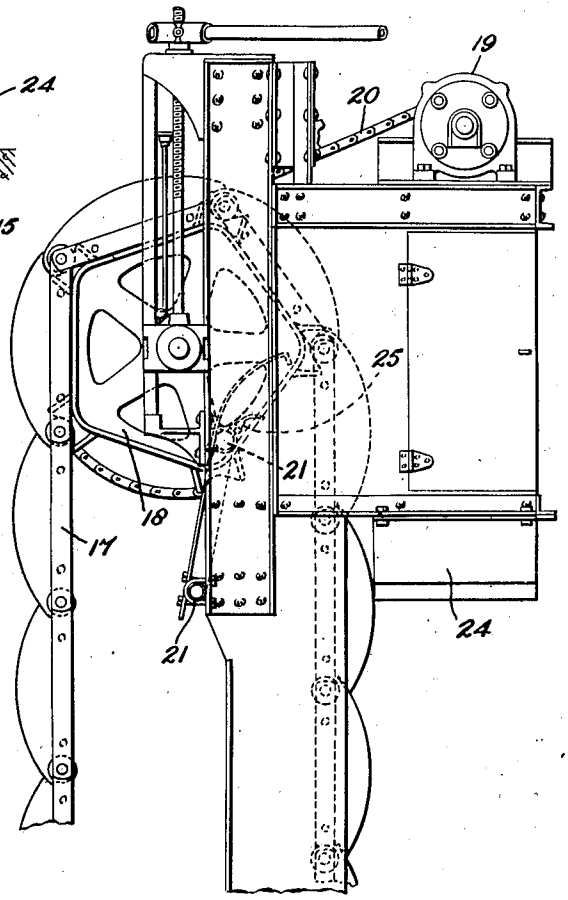

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Fig. 4.

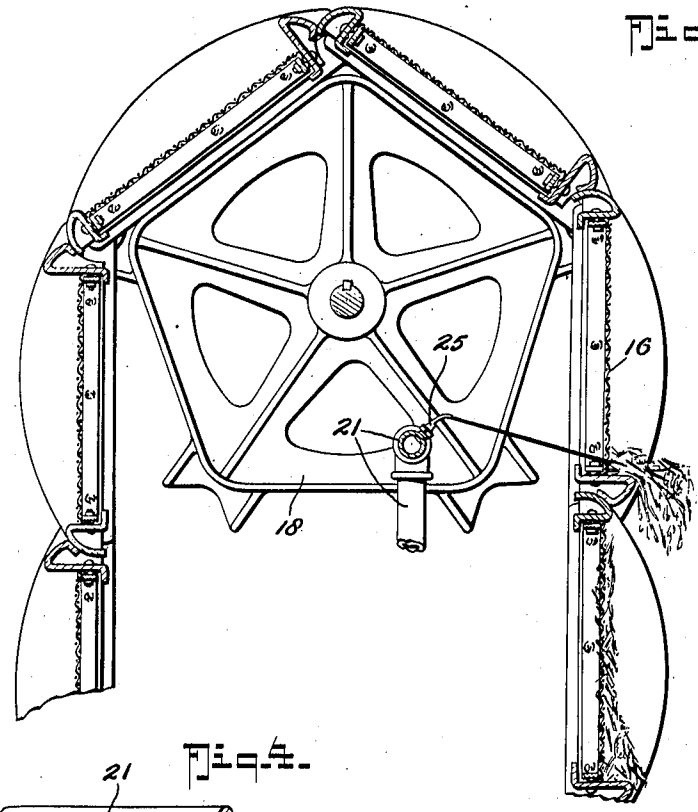


Fig. 7.

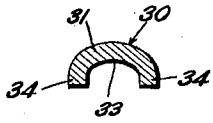


Fig. 8.

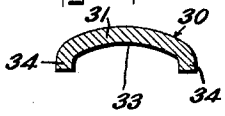


Fig. 9.

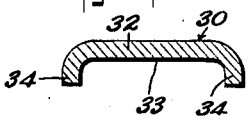


Fig. 10.

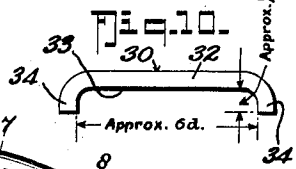
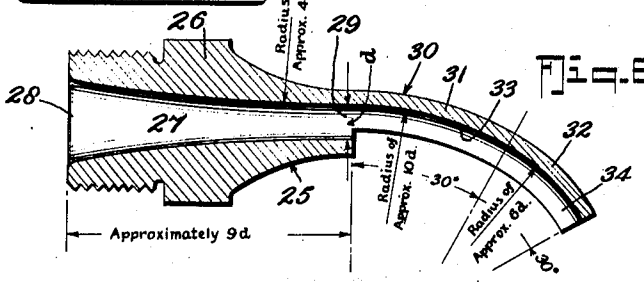


Fig. 5.

Fig. 6.



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FLUID PROJECTOR

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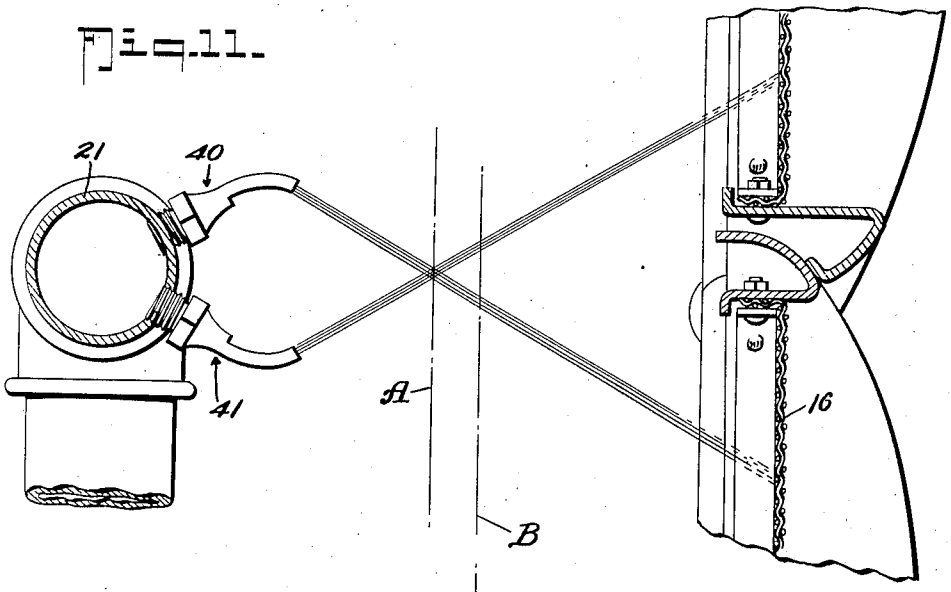
Fig. 11.



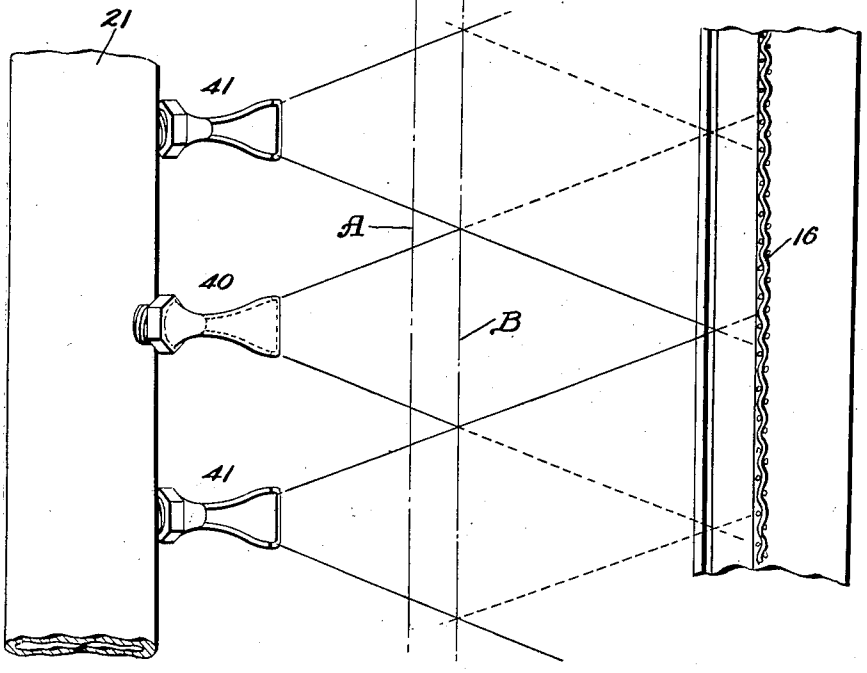


Fig. 12.

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Patented Feb. 20, 1934 1,947,752

UNITED STATES PATENT OFFICE

1,947,752

FLUID PROJECTOR

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Application February 3, 1930. Serial No. 425,623

3 Claims. (Cl. 299—121)

This invention relates to fluid projectors for cleaning purposes and the like, which are particularly adapted for use wherever a comparatively thin flat solid body of fluid is desirable, and has for one of its objects to provide a device of this character which will project a fluid under pressure in a thin flat stream of uniformly strong hitting force in all parts of its effective width.

A further object of the invention is to provide an improved projector which will change a solid body of fluid issuing from a round orifice into a flat sheet of uniform thickness throughout, with a minimum dispersion of the fluid.

While the invention has found wide use in the removal of debris from traveling water screens, and for purposes of disclosure has been illustrated and will be described in this connection, it will be readily apparent to those skilled in the art that it is equally susceptible of numerous other uses. For example, it may be employed in the construction material industry for cleaning sand, gravel, crushed stone, and the like; in the steel industry, for removing scale and/or other adhering foreign objects from the surfaces of sheets or plates; in the meat packing industry, to wash carcasses and parts thereof; and in fact, wherever uniformity of the cross section and impact force of a thin flat sheet of fluid is required.

With the above and other objects in view which will appear as the description proceeds, the invention consists in the novel details of construction and combinations of parts more fully hereinafter disclosed and particularly pointed out in the appended claims.

Referring to the accompanying drawings forming a part of this specification in which like reference characters designate like parts in all the views:—

Figure 1 is a front elevational view of a traveling water screen of well known construction illustrating the application of the cleaning apparatus constituting the present invention thereto;

Figure 2 is a side elevational view of the head portion of the screen shown in Figure 1 as seen from the left of the said figure;

Figure 3 is a vertical sectional view through the head portion of the screen, on a somewhat enlarged scale, certain of the parts appearing in Figures 1 and 2 being omitted for the sake of clearness;

Figure 4 is an enlarged front elevational view of one of the projectors constituting a part of the present invention together with a portion of its supply pipe;

Figure 5 is a side elevational view of the projector shown in Figure 4;

Figure 6 is a central longitudinal sectional view of the projector shown in Figs. 4 and 5;

Figures 7, 8 and 9 are cross-sectional views through the deflector portion of the projector taken respectively on the planes indicated by the lines 7—7, 8—8 and 9—9 of Figure 5;

Figure 10 is an end elevational view of the deflector portion of the projector as viewed along the line 10—10 of Figure 5;

Figure 11 is a diagrammatic sectional elevational view illustrating the manner of mounting two sets of the projectors so as to cause the streams or sheets of fluid projected thereby to cross one another and to impinge on the screen or other surface to be cleaned in different directions; and

Figure 12 is a diagrammatic plan view of the parts shown in Figure 11.

In order that the precise nature of the invention may be more clearly understood it may be said that it has been found quite a problem to properly clean a wide moving surface such as a water screen of the type shown in Patents Nos. 1,191,115 and 1,208,655, to Benjamin S. Reynolds; Patent No. 1,417,205, to Gustav R. Roddy, and others. The waste or refuse screened out of water streams and impinged against the screen surface of these machines is of a wide and varied nature, such as natural waste (leaves, twigs, bark, grass and straw); marine life (small fish, and minnows); and industrial waste (hair, felt, chips and pulp).

The screen mesh is necessarily fine enough to prevent such refuse from passing through, and it also must be as coarse as possible in order not to unduly restrict the flow of the water. This results in fibrous refuse being caught in the mesh of the screen. For cleaning off this refuse from the surface of various types of screens, brushes, scrapers and water hosing have been employed, but because of the lifting lips of the screen baskets of the endless traveling type of screen shown in the above patents, brushes and scrapers cannot be effectively used. It has therefore been necessary to depend upon the use of water under pressure against the rear side of the screen to clean this refuse off of the screen. To clean the screen surface by means of spray water has required large volumes of water at a relatively high pressure because of inefficiency of the nozzles in directing the water against the screen, and the nozzles are apt to clog with fine fibres, thus leaving a portion of the screen surface not

cleaned. The water from these nozzles is apt to strike the screen in finely divided streams and there is considerable loss of pressure due to the internal cross currents in the water stream, as delivered from the nozzle.

To clean the screen surface by the use of water in a through and economical manner of the various sorts of waste heretofore mentioned, it is important that the water be projected with considerable impact force at an acute angle against the screen surface in a solid wall of water without any cross currents or finely divided spray. From experience, observation and close study of the problem I have devised a liquid projector which is more effective in its cleaning of the screen and more economical in the use of water than has hereto been possible.

The problem presented is to take a solid body of water which is issuing from a round orifice and change its shape into a thin solid wall of water without losing pressure or velocity and without setting up cross currents in the water stream. To accomplish this result it is necessary that the walls of the orifice and the accompanying mechanism shall be smooth; that the orifice shall be in the form of a long tube having a large diameter of entry, the tube being reduced gradually in diameter, somewhat in the shape of a curve to the required orifice diameter; that the length of the projecting tube bear a certain ratio or relation to the diameter of the orifice; that when the stream issues from the orifice it must be gradually and uniformly deflected in its course; that the total angle of deflection should be approximately 60 degrees measured about the various centers of curvature of the deflectors; that the primary deflection of the stream should bear a certain ratio to the diameter of the orifice and that its final deflection should bear a different ratio to the diameter of the orifice. I have also discovered that to keep the water in a solid thin body the deflector surface must be smooth and be so shaped as to gradually change the water from a round body to a solid flat body, and that the deflector must have lips or side projections approximately one-half the diameter of the orifice. The juncture of these side lips with the end of the orifice must be at a sharp angle and also the end of the orifice must be at a sharp angle. The length of the projecting tube should be approximately nine times the diameter of the orifice; the curvature of the sides gradually restricting the tube from the large entry diameter to the orifice diameter should be approximately forty-two times the diameter. The first portion of the deflector should be curved through an arc of approximately 30° measured about its center on a radius approximately ten times the diameter of the orifice and the latter portion of the deflector should be curved through an arc of approximately 30° measured about its center on a radius approximately six times the diameter. The flare of the deflector at its outer end should be approximately six times the diameter of the orifice. A projector made along the above lines has been found to be most economical in the use of water because cross currents are avoided in the stream, the loss of head due to the change in direction of the stream is a minimum and the projector may be attached to the water supply pipe in such a manner as to project the water against the screen at an acute angle to its surface.

While projectors as above described are adapted for use in a single series to produce a single flat wall of water, the invention also includes a method of projecting the cleaning water in two solid thin walls at acute angles to each other and to the screen surface in order to thoroughly cleanse the screen of fibrous material which is caught in the screen mesh. In this phase of the invention, two series of projectors are set at an angle to each other in such manner that the water from one set of projectors strikes the screen at an acute angle in one direction and the water from the second set of projectors strikes the screen at an acute angle in the opposite direction so that any fibres clinging to the screen are bent downwardly by the first set of projectors and are bent upwardly and thrown out of the screen surface by the second set of projectors. The two sets of projectors are so arranged that the water from one set crosses the water from the second set but there is no interference between the two solid streams of water.

As an illustrative embodiment of the foregoing, reference is now made to the accompanying drawings and more particularly to Figs. 1 to 10 thereof. In Figs. 1, 2 and 3 there is shown, somewhat diagrammatically, an endless traveling water screen 15 comprising a series of screen surfaces 16 carried by chain links 17 which pass about head sprockets 18 which are adapted to be driven by a motor 19 through a belt or chain 20 all as is well known in the art. As the screen surfaces 16 become clogged with refuse strained from the water which is being screened, they are raised through the operation of the motor 19 thus bringing clean surfaces into position to continue the screening uninterruptedly.

For the purpose of dislodging the refuse from the surfaces 16 as they are lifted, there is provided a supply pipe 21 leading from any suitable source of water supply and which may be controlled by the valve 22. The said pipe is usually mounted behind the screen surfaces 16 as shown in Figs. 1, 2 and 3 and is tapped at spaced intervals for the reception of a series of nozzles or projectors 25 which are adapted to discharge water or other fluid against the rear of the said surfaces 16 to dislodge the refuse therefrom. The water and refuse are received in a trough 24 from which they are led to any suitable place of disposal.

The nozzles or projectors 25, when constructed in accordance with the present invention, comprise a body 26 which is provided with a longitudinal bore 27 extending therethrough. As best shown in Figs. 5 and 6, this bore tapers from its inlet end 28 to its discharge orifice 29 and the tapering walls are arcuate, being struck on a radius which is approximately forty-two times the diameter of the bore at its smallest point. The body 26 is of such length that the length of the bore 27 is approximately nine times its diameter at the discharge orifice 29. By maintaining the circular cross section and tapering the bore in this manner and curving its wall upon approximately this arc, as well as by maintaining substantially the relationship stated between its length and smallest diameter, the bore is not only rendered substantially non-clogging but it also effectively prevents any substantial reduction in pressure of the discharged fluid due to frictional loss and eddy currents.

The bore 27 is, of course, circular in cross-section and discharges at its orifice 29 a solid circular stream of fluid. It is, however, desirable that the fluid be spread so that it will impinge upon the surface to be cleaned in the

form of a solid flat sheet without any substantial amount of spray. For this purpose there is provided at the discharge end of the body 25, a deflector 30 which preferably takes the form of a longitudinally curved integral extension of the said body which is open at its lower side, and which flares or diverges outwardly in transverse dimensions, as clearly indicated in Figs. 4 to 10 inclusive. As above stated, I have found it necessary in order to secure the best results that the said deflectors have an initial curvature, the radius of which bears a certain definite relation to the diameter of the discharge orifice, and that it have a final curvature the radius of which bears a different relation to the diameter of the discharge orifice. This is clearly brought out in Fig. 6 of the drawings, wherein that portion 31 of the deflector 30 which extends through an arc of 30° from the discharge orifice is curved downwardly upon a radius which is approximately ten times the diameter of the discharge orifice, while that portion 32 of the deflector which extends through an arc of 30° beyond the first mentioned portion 31 has a radius of a curvature which is approximately six times the diameter of the discharge orifice.

The deflector 30 flares or diverges outwardly, and varies in cross-section from a substantial semi-circle where it joins the discharge orifice 29 to a semi-rectangular shape at its extreme end as shown in Fig. 10. As above set forth the inner deflecting surface 33 of the deflector constitutes a smooth continuation of the bore 27 where the two meet at the discharge orifice 29, and the outer end of the deflector has a width of approximately 6 times the diameter of the orifice 29. The side walls 34 of the deflector are of a depth which is approximately one-half the diameter of the discharge orifice 29.

As above set forth, it has been found as a result of considerable actual experimentation, that the solid round stream of water which issues from the discharge orifice 29 of the bore 27 is transformed into a flat solid sheet of water substantially without spray or waste when the various parts of the deflectors 30 are constructed substantially in accordance with the relations given.

While the projectors 25 just described in detail are adapted for use in a single series as shown in Figs. 1, 2 and 3, it has been found that they are especially adapted for use in a double series as illustrated in Figs. 11 and 12 so that two solid sheets of clean water or other fluid may be projected against the surface to be cleaned in different directions. As clearly shown in the last mentioned figures the supply pipe 21 is tapped for the reception of two rows or sets, 40 and 41, of projectors which are arranged at a substantial angle to one another around the circumference of the pipe. The projectors of the set 40 are staggered longitudinally of the pipe relative to those of the set 41 and those of the set 40 are arranged to discharge their fluid at a downward angle while those of the set 41 are arranged to discharge at an upward angle.

The planes in which these different discharges are directed intersect along the line A of Figs. 11 and 12, but since sheets of discharged fluid have not diverged sufficiently to overlap at this line of intersection, there is no interference between the crossing sheets and each sheet continues without interruption, to its line of impingement against the screen surfaces 16 of the baskets as clearly indicated in Fig. 11. The divergence of the sheets is such that they begin to overlap, when viewed in plan, along the line B of Figs. 11 and 12 and this divergence continues until at or just before the sheets strike the surfaces 16, the individual sheets of each set of projectors join, whereby there is provided along each line of impingement, a solid wall or sheet of water under considerable pressure and without any substantial amount of spray which effectively dislodges the refuse from the surfaces 16 and carries it into the trough 24 as above described.

As above stated, actual experiments have shown projectors constructed in substantial accordance with the relative dimensions above given to be far more effective in cleaning the screen surfaces of traveling water screens than those which have been heretofore employed and the double arrangement illustrated in Figs. 11 and 12 is particularly effective where there is a large amount of refuse collected which mats and becomes entangled with the elements of the screens.

While it is customary to employ water under pressure in these devices, obviously other fluids, such for example, as steam or compressed air, may be employed if desired.

These projectors obtain a maximum efficiency, since they cause a minimum amount of fluid to act upon a maximum area of screen or other surface to be cleaned, in solid flat walls, and with a force at the point of contact which is substantially equal to the pressure in the supply pipe 21. It thus results that lower pressures may be used in this pipe than has been heretofore practical with previous types of spray nozzles which have materially reduced the pressure of the water at impact, rendering necessary higher initial pressure to obtain the desired cleaning force.

It is obvious that those skilled in the art may vary the details of construction as well as the precise arrangement of parts without departing from the spirit of the invention and, therefore, it is not wished to be limited to the above disclosure except as may be required by the claims.

What is claimed is:

1. A fluid projector for transforming a solid round stream of fluid under pressure into a solid unbroken flat sheet without substantial loss of fluid in the form of ineffective spray, and with minimum loss of head, comprising a body having a tapering longitudinal bore therethrough the walls of which are convex in longitudinal section; and a transversely divergent deflector constituting an extension of said body, and terminating in a straight transverse edge, said deflector comprising a pair of contiguous longitudinally curved sections, the one nearest said body extending through an arc of substantially 30° measured about its center, with a radius of curvature which is approximately ten times the diameter of the discharge orifice of the bore, the next adjacent section extending through an arc of substantially 30° measured about its center, with a radius of curvature which is approximately six times the diameter of said orifice, the deflecting surface of said deflector constituting a smooth continuation of said bore and varying in cross section from a semi-circle adjacent said discharge orifice, having the same diameter as the orifice, to a semi-rectangle at the discharge end of the deflector the width of which is approximately six times the diameter of the orifice, the side walls of said deflector being of a substantially uniform depth

throughout which is approximately equal to one half the diameter of the orifice.

2. A fluid projector for transforming a solid round stream of fluid under pressure into a solid unbroken flat sheet without substantial loss of fluid in the form of ineffective spray, and with minimum loss of head, comprising a body having a longitudinal bore therethrough; and a transversely divergent deflector constituting an extension of said body and terminating in a straight transverse edge, said deflector comprising a plurality of contiguous longitudinally curved sections, the one nearest said body extending through an arc of substantially 30° measured about its center, with a radius of curvature which is approximately ten times the diameter of the discharge orifice of said bore, the next adjacent section extending through an arc of substantially 30° measured about its center, with a radius of curvature which is approximately six times the diameter of said orifice, the deflecting surface of said deflector constituting a smooth continuation of said bore and varying in cross section from a semi-circle adjacent said discharge orifice, having the same diameter as the orifice, to a semi-rectangle at the discharge end of the deflector, the width of which is approximately six times the diameter of the orifice, the side walls of said deflector being of substantially uniform depth throughout.

3. A fluid projector for transforming a solid round stream of fluid under pressure into a solid unbroken flat sheet without substantial loss of fluid in the form of ineffective spray, and with minimum loss of head, comprising a body having a longitudinal bore; and a transversely divergent deflector constituting an extension of said body and terminating in a straight transverse edge, said deflector comprising a pair of contiguous longitudinally arcuate sections of determinate length struck from different centers with successively diminishing radii, the deflecting surface of said deflector forming a smooth continuation of said bore where it joins the same at the discharge orifice, and varying in cross section from substantially a semi-circle adjacent said orifice, to a semi-rectangle at the discharge end.

ALVIN H. BENESH.