July 16, 1946. C. F. ZIMMERMANN 2,404,203

EXHAUSTER

Filed Aug. 20, 1942 3 Sheets-Sheet 1

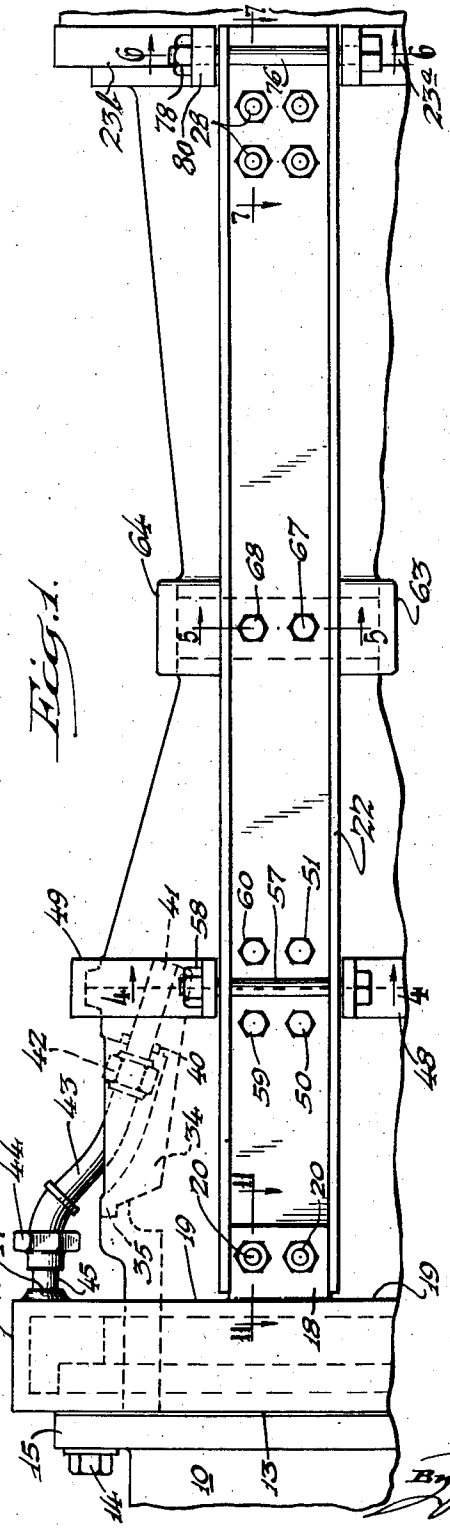


Fig. 1.

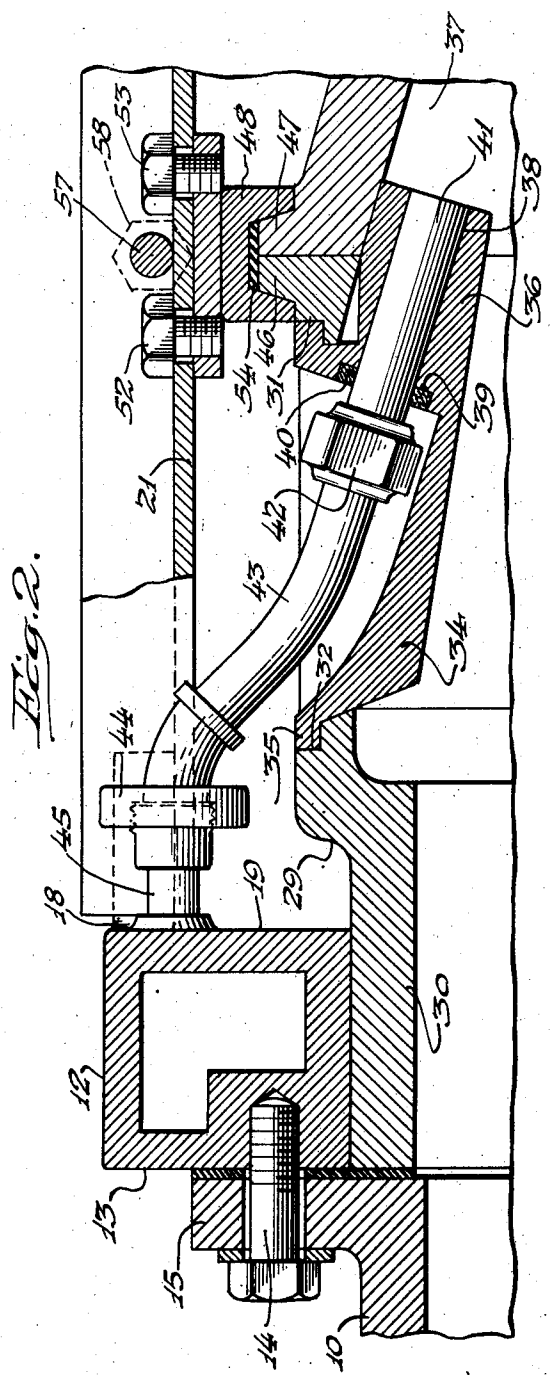


Fig. 2.

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EXHAUSTER

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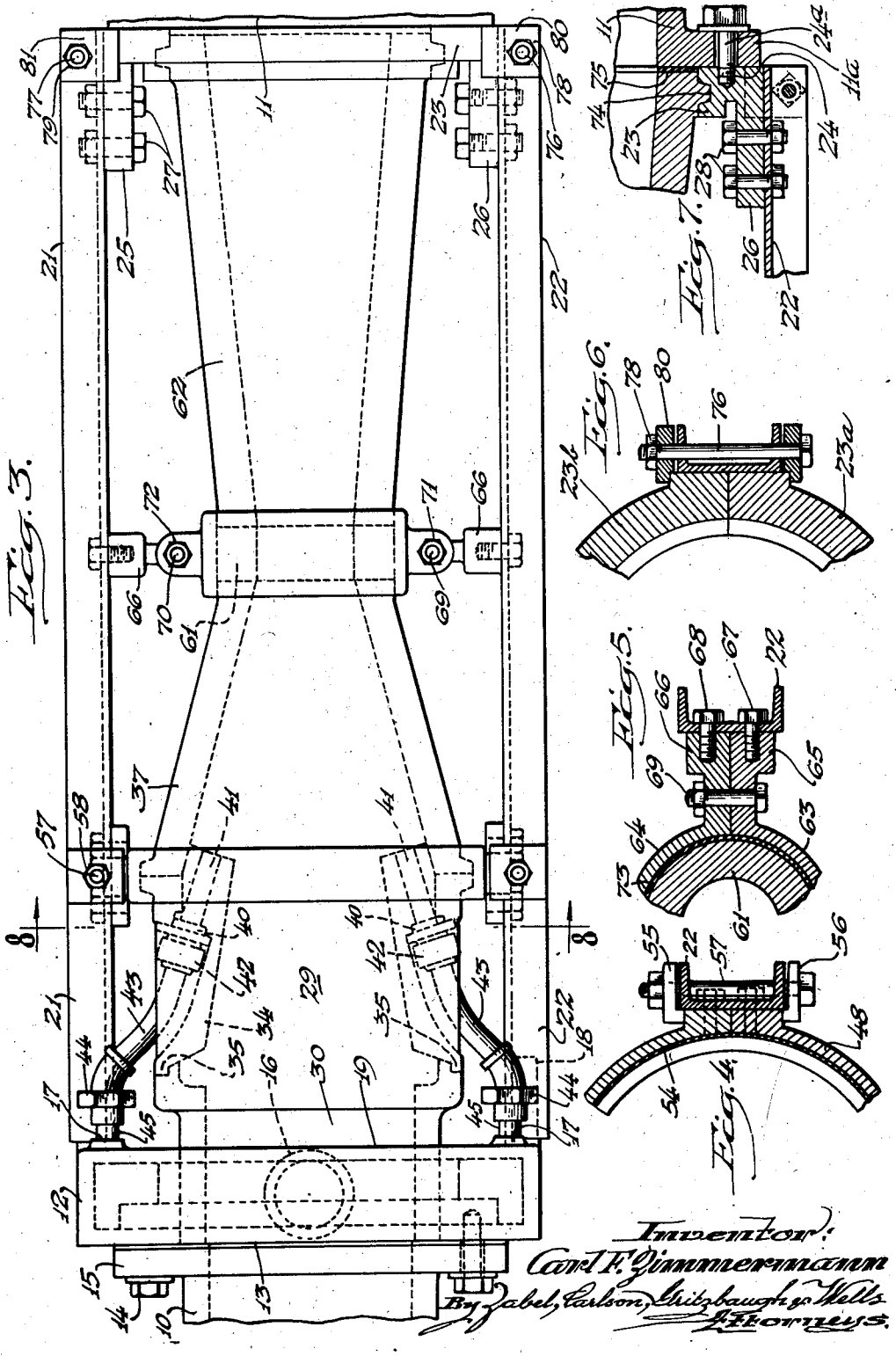


Fig. 3.

Fig. 7.

Fig. 6.

Fig. 5.

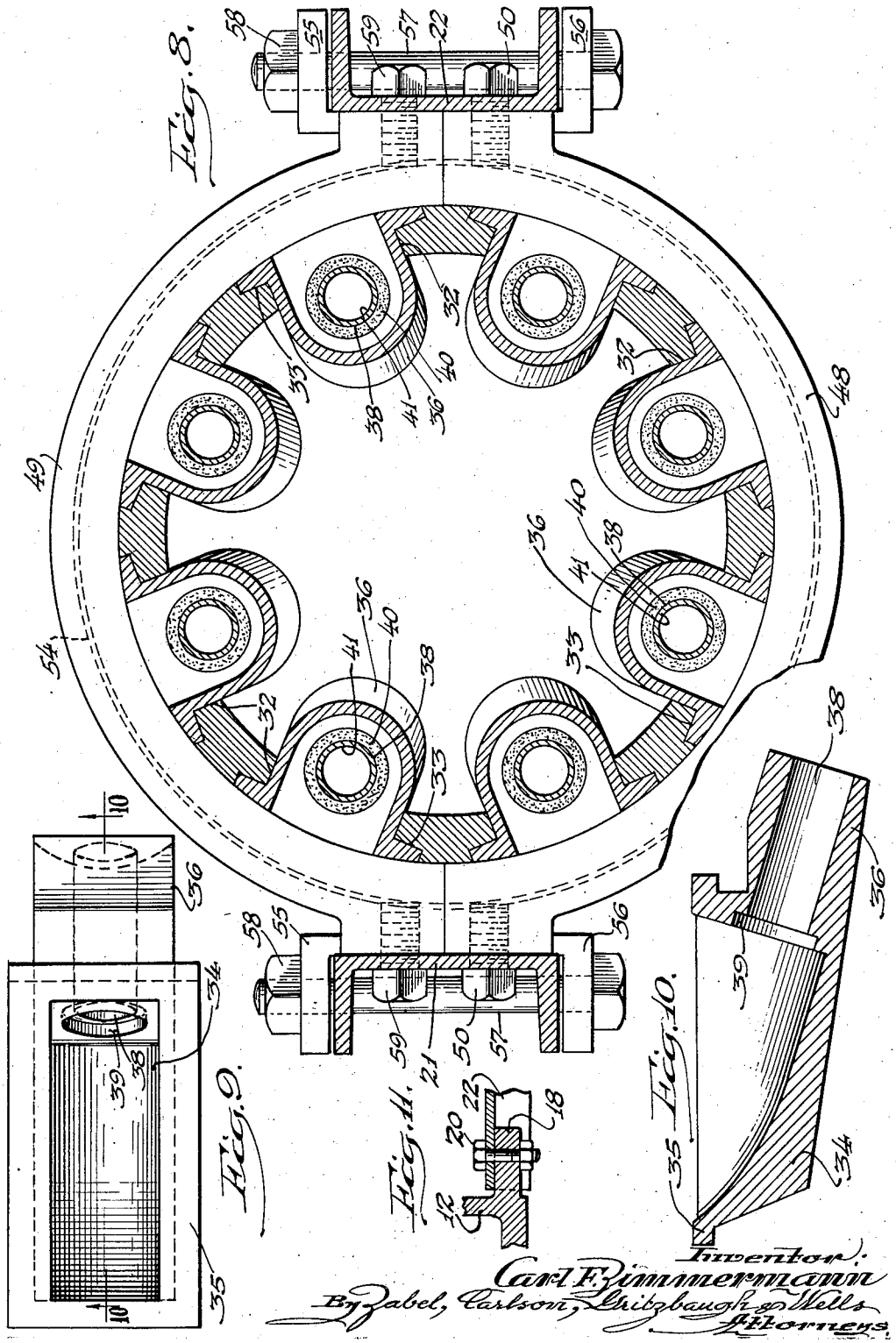
Fig. 4.

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EXHAUSTER

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UNITED STATES PATENT OFFICE

2,404,203

EXHAUSTER

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Application August 20, 1942, Serial No. 455,538

10 Claims. (Cl. 302—25)

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The present invention relates to exhausters and is particularly directed to improvements in exhausters of the type wherein a fluid jet such as steam is introduced into a conduit for the purpose of establishing a vacuum in the conduit and inducing flow of air through the conduit to enable the air stream to transport granular materials held in suspension therein. Exhausters of this type are generally well known as parts of conveyor systems for conveying ashes and the like.

The principal purpose of the present invention is to provide an exhauster of the character mentioned above which when inserted in a conduit may have any of the fast wearing parts replaced or may be changed to fit different operating conditions without breaking a main joint in the conduit and without disturbing those elements such as the manifold and the suction chamber and discharge conduit coupling flange that are essentially the same for all operating conditions.

In the basic design of exhausters of this character the different degrees of vacuum to be established, the steam pressure to be used, and other operating conditions often require substantial variations in the contour, size and design of the mixing chamber, throat and discharge tube of the exhauster proper as well as changes in the angle at which the steam nozzle discharges into the mixing chamber and changes in the interior construction of the nozzle itself. The present apparatus is particularly directed to a device whereby such design changes may be made in the parts above referred to without in any way affecting the manifold, the suction chamber, the discharge flange and the connecting frame members. Variations in the angle at which the nozzle is directed into the suction chamber are taken care of by different nozzle housings while the mixing chamber, the throat and discharge tube, which together with the suction chamber make up that part of the exhauster called the diffuser tube, have their interior dimensions and contours variable without changing the overall dimensions and the exterior contours. The savings in manufacture and maintenance because of the aforementioned features are numerous. Standard parts for the manifold suction chamber casting, the discharge flange and the frame members may be employed. Also, the patterns for the other parts remain the same, it being necessary only to change the cores thereof to suit the desired design. It is obvious that the quantities of material which must be carried in stock are greatly reduced.

It is also an object of the invention to provide

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an exhauster of this character wherein elimination of erosive wear on the steam manifold is complete.

It is a further purpose of the invention to provide in an exhauster of the character described a construction wherein the nozzles which direct steam or other fluid from the manifold into the mixing chamber of the exhauster are protected from abrasion by the material passing through the exhauster and are readily accessible from the exterior of the exhauster so that they may be removed and replaced without necessity for removing any other part of the exhauster. The invention contemplates also that the protecting means by which the nozzles are protected from abrasion may also be readily replaced without disturbing the various parts of the exhauster.

It is a further purpose of the invention to provide in an exhauster of the character described an improved combination of a suction chamber with the manifold and mixing chamber whereby the efficiency of the exhauster as a whole is materially increased.

The present invention contemplates also as an object an exhauster wherein all of the wear parts such as the tubular members making up the suction chamber, the nozzle protectors, the mixing chamber, the throat and the discharge tube constitute individual elements normally rigidly held in place but readily replaceable while the main joints of the conduit and the manifold remain connected in their usual fashion, the arrangement being such that during the removal and replacement of a part the means connecting the exhauster in the line of the conduit remain to form a cradle or support for the new part until it is clamped in place.

The features and advantages of the invention will appear more fully from the following description, reference being had to the accompanying drawings wherein a preferred form of the invention is shown. It should be understood however that the drawings and description are illustrative only and are not to be taken as limiting the invention except insofar as it is limited by the claims.

In the drawings:

Fig. 1 is a view in side elevation of an exhauster assembly embodying my invention, certain of the steam jet nozzles being left off for the sake of clearness, and the lower portion of the device being broken away;

Fig. 2 is an enlarged sectional view taken lengthwise through a portion of the exhauster illustrating the manifold construction and its con-

nection in the conduit line along with the frame members which serve to lock together two edges of the conduit between which the exhauster is inserted;

Fig. 3 is a plan view of the exhauster, certain of the nozzles being left out for the sake of clearness;

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 1;

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 1, further illustrating the coupling of a conduit to the discharge end of the exhauster;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 3 but on an enlarged scale;

Fig. 9 is a plan view of one of the eight nozzle housings that are embodied in the device;

Fig. 10 is a sectional view on the line 10—10 of Fig. 9; and

Fig. 11 is a fragmentary sectional view taken on the line 11—11 of Fig. 1.

Referring now in detail to the drawings, the present invention is embodied in an exhauster, the purpose of which is to establish a vacuum in a receptacle or conduit which is connected to the inlet side of the exhauster whereby to induce a flow of air into, through and out of the receptacle or conduit. The exhauster is often required to serve as a part of the conduit into which it is inserted, and the conduit is used to transport granular materials which are carried in suspension by the air stream that is caused to flow through the conduit by means of the exhauster. This granular material of course travels through the exhauster.

One of the principal uses for devices of this character is in the conveying of ashes. Naturally the material in the ash may be highly abrasive and it always presents a problem of replacement of parts that become worn or damaged due to the abrasive action of the material conveyed through the exhauster. The present exhauster is so constructed as to provide a highly efficient vacuum creating and conveying device with facilities whereby the abrasive action of the material conveyed occasions a minimum amount of shutdown for replacement of parts.

Referring now to Figs. 1, 2, 3 and 8, my invention is shown as mounted in a conduit line consisting of an inlet section 10 and a discharge section 11. A steam manifold 12 has one face 13 thereof drilled to receive bolts 14 which pass through a flange 15 of the conduit 10 so that the manifold can be attached directly to the conduit. The manifold 12 has an inlet opening 16 and has a plurality of outlets 17, there being eight of the outlets 17 in the form of device shown. Of course the number of outlets may be changed to suit any particular installation.

The manifold 12 also has two oppositely disposed lugs 18 which project from its face 19 opposite the conduit receiving face 13. These lugs 18 are drilled or cored to receive two bolts 20 in each lug, these bolts serving to attach two frame members 21 and 22 to the manifold 12. The frame members 21 and 22 extend in parallel relation from the manifold 12 to a discharge flange 23 which is in the form of a split ring and which is provided with threaded holes 24 by which it may be bolted to a flange 11a on the conduit 11. The discharge flange 23 has two lugs 25 and 26

thereon to which the frame members 21 and 22 are bolted by a plurality of bolts 27 and 28, the bolts 27 serving to attach the frame member 21 to the lug 25 and the bolts 28 serving to attach the frame member 22 to the lug 26. The frame members 21 and 22 are constructed of steel channels.

A suction chamber casting 29 which is cylindrical in cross section has a reduced portion 30 that slides into the manifold 12 to abut against the conduit 10 and form a continuation thereof. This suction chamber casting has an enlarged annular portion 31 which is provided with a multiplicity of rectangular apertures 32 around the periphery thereof. These apertures are uniformly spaced and in the present form there are eight of them. The wall around each aperture is recessed as indicated at 33 to provide a seat for a nozzle housing 34 which has a rectangular flange 35 around the periphery thereof. The nozzle housing is also a casting of a material that is designed to resist abrasion.

The nozzle housing is shown in plan view in Fig. 9 and in section in Fig. 10. The housing has a tubular portion 36 which is adapted to project beyond the end of the suction chamber casting into a mixing chamber 37 as illustrated in Fig. 2. The tubular portion 36 has a cylindrical bore 38 and the bore 33 is enlarged at 39 to receive a packing ring 40 (see Fig. 2). A nozzle 41 extends into the bore 38 and is connected by a coupling 42 to a length of pipe 43 that leads to a union coupling 44, one section of which is on the pipe 43 and the other section of which is upon a pipe 45 which is threaded into one of the outlets 17. It will be evident from the foregoing description that if it is desired to remove a nozzle 41 for purposes of replacement or repair of the nozzle or of the nozzle housing 34 the coupling 44 is loosened and the housing and nozzle can then be removed or the nozzle itself can be removed while the housing remains in place. The housing protects the exterior of the nozzle from abrasion but of course it does not protect the tip of the nozzle from abrasion due to the passage of steam through it. If a different nozzle is desired due to different characteristics of the exhauster it is possible to replace the present nozzle without disturbing the rest of the apparatus. Also, new housings and nozzles to provide a different direction of jet into the mixing chamber may be applied without disturbing the mounting of the suction chamber casting.

That part of the exhauster unit that I refer to as the diffuser tube is composed of the suction chamber 29, a mixing chamber casting 37, a throat casting 61 and a dscharge tube casting 62.

The mixing chamber 37 is a part of the diffuser where the steam from the nozzles 41 mixes with the material being drawn from the conduit 10. This mixing chamber is a casting, conical in shape, with its larger end of the same size as the outlet end of the suction chamber. Both castings 29 and 37 are provided with annular flanges at their meeting ends. The casting 29 has a flange 46 thereon and the casting 37 has a flange 47 thereon. These two flanges are clamped together by two split ring sections 48 and 49. The split ring section 48 is the bottom section (see Fig. 1) and is bolted to the frame members 21 and 22 by means of a pair of bolts 50 and 51 passing through the frame member 22 and a pair of bolts 52 and 53 passing through the frame member 21. The showing in Fig. 2 illus-

trates the construction of the split ring 48 and the manner in which the bolts 52 and 53 secure it in place. The bolts 50 and 51 of course secure the other side of the split ring in the same fashion. The split ring section 49 is a duplicate of the section 48 and the two ring sections are provided with a packing ring 54 to seal the joint between the two flanges 46 and 47 on the castings 30 and 37. In order to clamp the two split ring sections 48 and 49 together I provide two clamping lugs 55 and 56 (see Figs. 1 and 4) at each of the frame members, and these lugs are secured together by bolts 57 which pass through the flanges of the frame members 21 and 22 and which are provided with nuts 58 in order that the lugs 55 and 56 may be drawn together and in turn clamp the split ring sections together in the manner illustrated in Fig. 4. When the top ring section 49 is clamped in place it is then permanently fastened by means of suitable bolts 59 and 60 passing through each of the frame members 21 and 22 and threading into the section 49.

The small end of the mixing chamber castting 37 abuts a short cylindrical casting 61 which forms the throat of the diffuser. The inner size of the casting 61 is the same as the inner size of the mixing chamber casting 37. The discharge tube casting 62 abuts the other end face of the throat casting 61, the discharge casting 62 being conical in construction and increasing in diameter from the throat casting 61 to the conduit 11. The throat casting 61 and the castings 37 and 62 are clamped together by means of two split ring sections 63 and 64 (see Figs. 1, 3 and 5). The lower ring section 63 is permanently attached to the frame members 21 and 22 by two horizontally extending lugs 65 and the upper section 64 has similar lugs 66. The lugs 65 are bolted to the frame members 21 and 22 by bolts 67 and the lugs 66 are similarly bolted to the frame members 21 and 22 by bolts 68. The two ring sections 63 and 64 are clamped together by two bolts 69 and 70 which pass vertically through the lugs 65 and 66. The bolts 69 and 70 are provided with nuts 71 and 72. A packing ring 73 serves to seal the joints between the castings 37 and 62 on the one hand and the throat casting 61 on the other hand. It will be noted that the top ring section 64 can be removed by taking off the nuts 71 and 72 and releasing the bolts 68. Thus it is a fairly simple matter to replace a throat casting 61 whenever that is desired. The throat casting being at the point of smallest diameter in the entire exhauster is subject to the greatest wear and therefore should be capable of ready replacement with a minimum amount of difficulty. The present construction makes such replacement possible.

The discharge end of the discharge tube 62 is provided with an exterior rib 74 which seats in a corresponding recess in the discharge flange 23. I have previously described how the discharge flange 23 is in turn connected by means of bolts 24*a* that pass through a flange on the conduit 11 and are threaded into the holes 24 in the discharge flange. A packing ring 75 is interposed between the end of the discharge tube 62 and the adjacent face of the conduit 11. The two sections 23*a* and 23*b* of the discharge flange 23 are illustrated in Fig. 6 which also illustrates how these two sections are clamped together. Two bolts 76 and 77 having nuts 78 and 79 thereon pass through the flanges of the members 22 and 21, respectively, and serve to clamp two sets of clamping lugs 80 and 81 against the

corresponding shoulders provided on the sections 23*a* and 23*b*. The bolts 27 and 28 are arranged in sets of two for each section of the discharge flange 23 so that once the discharge flange is clamped in place the upper pair of bolts can be applied. The lower pairs of bolts are of course permanently used to fasten the lower half of the discharge flange 23 in place.

It is believed the construction of the exhauster will be clear from the foregoing description.

The principal features and advantages lie in the protection of the manifold by means of the suction chamber casting, the accessibility of the nozzles and their protection by means of the nozzle housings, and the ready access to any section of the exhauster without disturbing the connection between the conduits 10 and 11. It is believed to be evident from the foregoing description that the frame members 21 and 22, together with the manifold 12 and the lower half of the discharge flange 23, constitute a permanent and rigid connection between the conduits 10 and 11. The lower half of the discharge flange 23 coupled with the lower sections 63 and 48 also provide a cradle or support for the several castings 36 and 37 and 61 and 62 so that these castings may be laid in place and taken out and replaced with a minimum amount of difficulty.

The particular design of the suction chamber and the diffusing tube is such as to permit the nozzles to be advantageously used to direct the discharge from the nozzles into the throat of the exhauster with a minimum loss of available energy. This factor and the protection of the nozzles afforded by the nozzle housings tend to lengthen the life of the castings 37 and 61 which bear the brunt of the abrasive action of the material being drawn through the exhauster.

In each individual installation of an exhauster the factors which determine the particular nozzle that will be used and the particular mixing chamber, throat and discharge tube that will be used may be widely different from the factors encountered in another installation. For example, if a much higher vacuum must be maintained in the suction chamber, this does not require any redesign of the suction chamber but it does require changes in the nozzles, mixing chamber, throat and discharge tube. With my invention the basic parts of the exhauster, namely, the manifold, the suction chamber casting, the discharge flange and the frame members which connect the discharge flange to the manifold may be the same for a great variety of conditions so long as the conduits in which the exhauster is to be inserted are essentially the same in diameter. Changing conditions therefore in an installation requiring higher or lower vacuum may be made by changing only those parts which have to be changed to get the desired result, namely, the mixing chamber, throat, the discharge tube and the nozzles and their housings.

It is believed to be apparent from the foregoing description that I have provided an exhauster which is simple in construction and capable of adaption to a great variety of conditions encountered in individual installations with a minimum amount of change. It is also believed to be evident that the exhauster hereinbefore described is particularly adapted to keep maintenance cost at a low level by cutting down the replacement to only those parts that are actually worn, and making such parts readily accessible for replacement.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit, said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, spaced two-section connecting clamps attached to said frame members intermediate the ends thereof, a diffuser tube interposed between the manifold and the discharge flange and having a mixing chamber, a tubular throat portion and a tubular discharge portion, said portions being removably supported on said frame members by said clamps and said discharge flange, a suction chamber comprising a tubular member having an inlet end extending into the manifold whereby to protect the inner wall thereof, said tubular member having circumferentially spaced apertures therein, nozzle housings in said apertures and steam jet nozzles connected to the manifold and extending through said housings and apertures into the interior of the mixing chamber.

2. In an exhauster of the character described, a pressure fluid manifold of ring form, a suction chamber tube having an inlet portion registering with the opening through said manifold, said tube having nozzle mounting apertures peripherally spaced about it, said manifold having outlets therein outside the suction chamber tube and removable nozzles connected to said manifold to receive fluid from said outlets, said nozzles extending into the suction chamber tube through said apertures.

3. In an exhauster of the character described, a pressure fluid manifold of ring form, a suction chamber tube having an inlet portion registering with the opening through said manifold, said tube having nozzle mounting apertures peripherally spaced about it, said manifold having outlets therein outside the suction chamber tube, removable nozzles connected to said manifold to receive fluid from said outlets, said nozzles extending into the suction chamber tube through said apertures, and nozzle guards mounted in said apertures and shielding the walls of the nozzles from the interior of said tube.

4. In an exhauster of the character described, a pressure fluid manifold of ring form, a suction chamber tube having an inlet portion registering with the opening through said manifold, said tube having nozzle mounting apertures peripherally spaced about it, said manifold having outlets therein outside the suction chamber tube, and removable nozzles connected to said manifold to receive fluid from said outlets, said nozzles extending into the suction chamber tube through said aperture, said tube having seats about said apertures and said guards having flanges resting on said seats.

5. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit, said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame members and extending from the manifold to the discharge flange, said diffuser tube having fluid jet nozzle inlets in the periphery thereof adjacent to the manifold, and fluid jet nozzles connected to the manifold and extending through said nozzle inlets.

6. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit, said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame and extending from the manifold to the discharge flange, and clamping means carried by said frame members securing said diffuser tube to said members, said diffuser tube comprising a plurality of tubular sections and said clamping means comprising split rings covering the joints between said sections.

7. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit, said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame and extending from the manifold to the discharge flange, said diffuser tube comprising a tubular suction chamber section having an inlet portion extending into the manifold ring protecting the inner wall thereof from abrasive action of the material passing through the manifold ring, a conical mixing chamber section abutting said casing, a throat section abutting the mixing chamber section, and a conical discharge section abutting the throat section and extending to the discharge flange.

8. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit, said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame and extending from the manifold to the discharge flange, said diffuser tube comprising a tubular suction chamber section having an inlet portion extending into the manifold ring protecting the inner wall thereof from abrasive action of the material passing through the manifold ring, a conical mixing chamber section abutting said casing, a throat section abutting the mixing chamber section and a conical discharge section abutting the throat section and extending to the discharge flange, said suction chamber section having peripherally spaced nozzle inlets therein and removable nozzle housings in said inlets.

9. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit,

said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame and extending from the manifold to the discharge flange, said diffuser tube comprising a tubular suction chamber section having an inlet portion extending into the manifold ring protecting the inner wall thereof from abrasive action of the material passing through the manifold ring, a conical mixing chamber section abutting said casing, a throat section abutting the mixing chamber section and a conical discharge section abutting the throat section and extending to the discharge flange, said suction chamber section having peripherally spaced nozzle inlets therein, outlet conduits connected to the manifold at peripherally spaced points thereon outside of and around the suction chamber section, and fluid jet nozzles on said conduits extending through said inlets.

10. In a steam jet exhauster of the character described, a steam manifold of ring form having means on one face thereof for connection to a conduit, oppositely disposed frame members affixed to said manifold and projecting from said manifold in the direction opposite to the conduit,

said frame members having a discharge flange affixed thereto at the ends remote from the manifold, said discharge flange having means for attachment of a conduit thereto, a diffuser tube secured to the frame and extending from the manifold to the discharge flange, said diffuser tube comprising a tubular suction chamber section having an inlet portion extending into the manifold ring protecting the inner wall thereof from abrasive action of the material passing through the manifold ring, a conical mixing chamber section abutting said casing, a throat section abutting the mixing chamber section and a conical discharge section abutting the throat section and extending to the discharge flange, said suction chamber section having peripherally spaced nozzle inlets therein, outlet conduits connected to the manifold at peripherally spaced points thereon outside of and around the suction chamber section, fluid jet nozzles on said conduits extending through said inlets, and nozzle housings in said inlets protecting the portions of the nozzles interiorly of the suction chamber section from abrasion by material passing through said section.

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