Oct. 19, 1943. E. ERICKSSON 2,332,067

DRIER

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Fig. 1

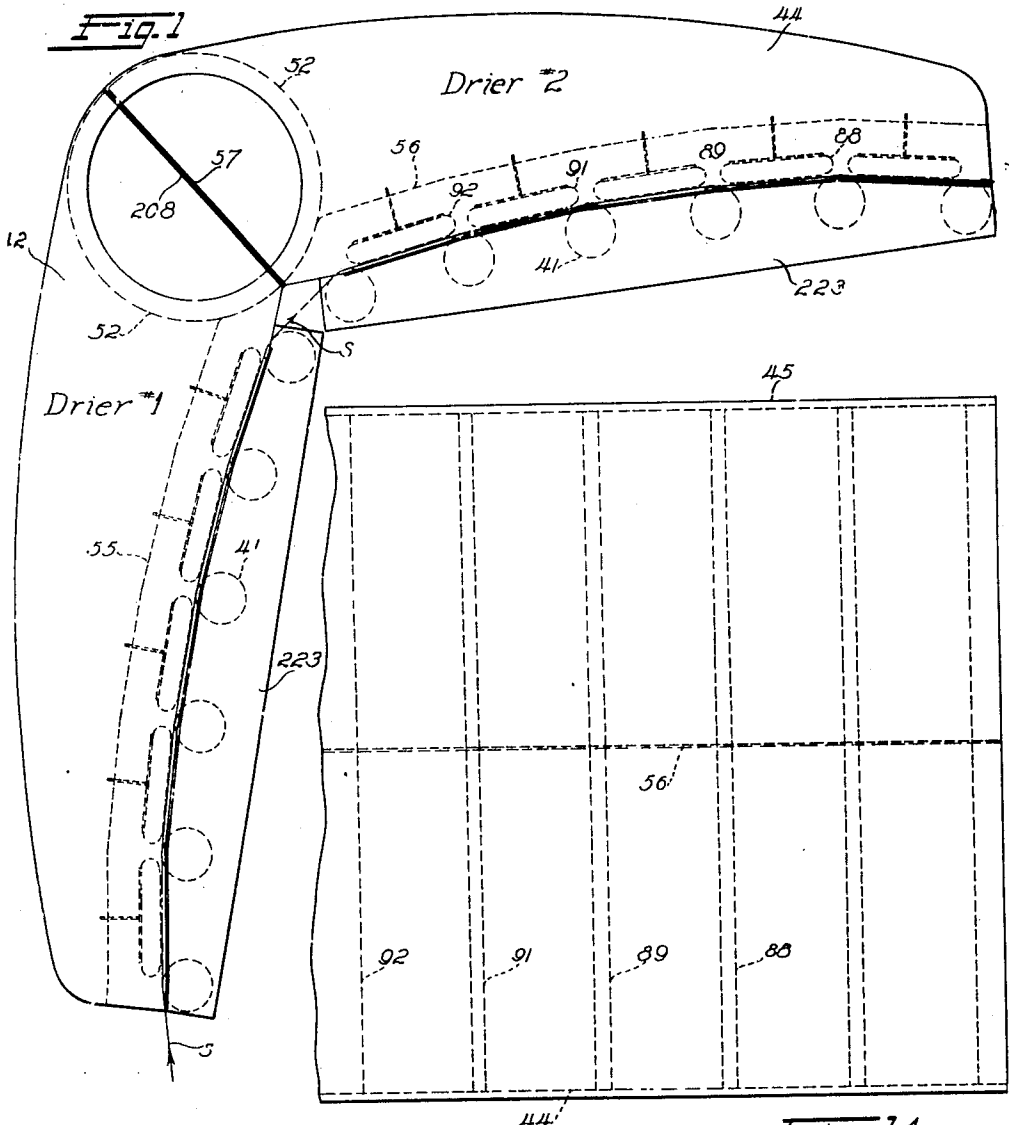


Fig. 1A

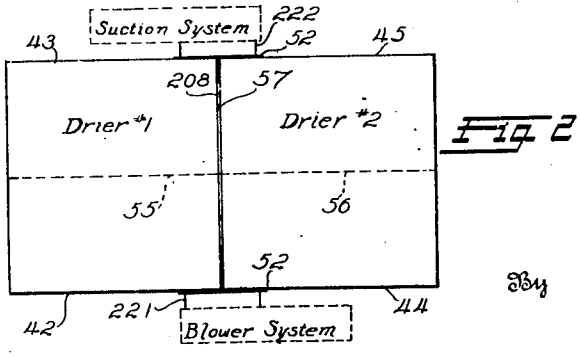


Fig. 2

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DRIER

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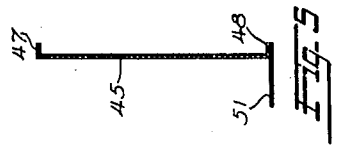


Fig. 5

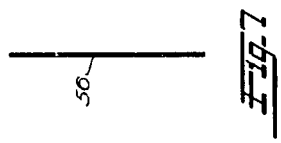


Fig. 7

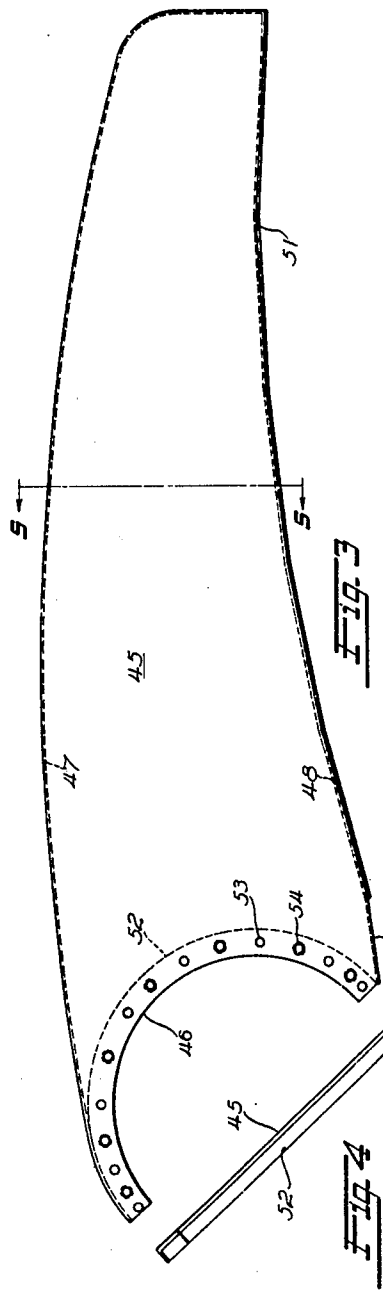


Fig. 3

Fig. 4

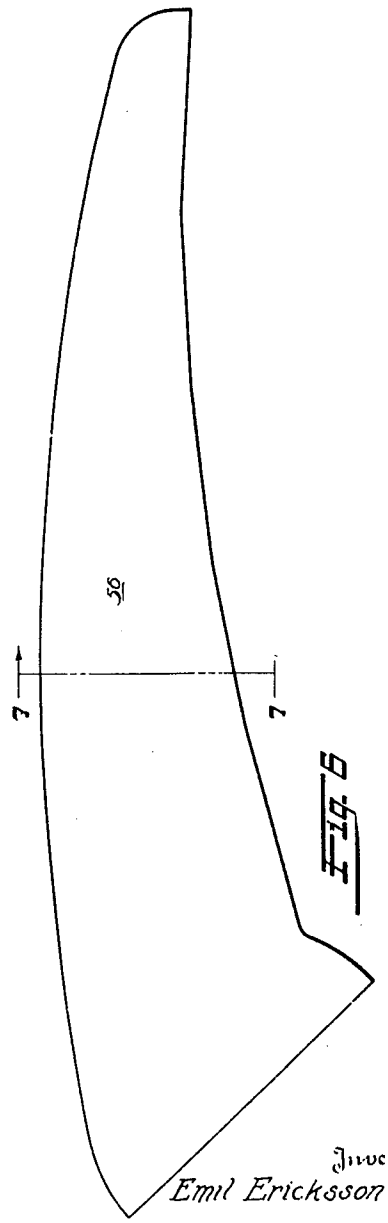


Fig. 6

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DRIER

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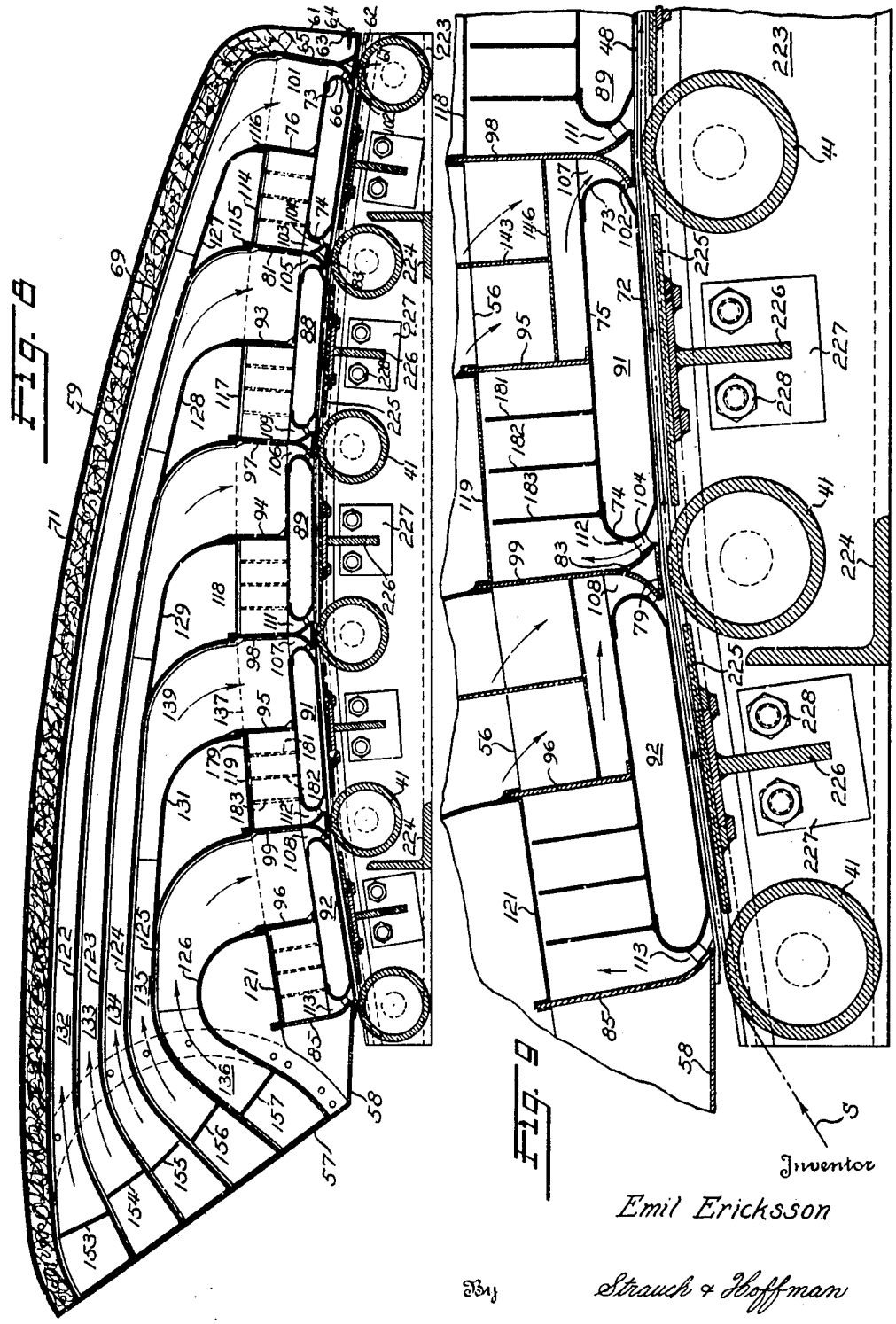


Fig. 8

Fig. 9

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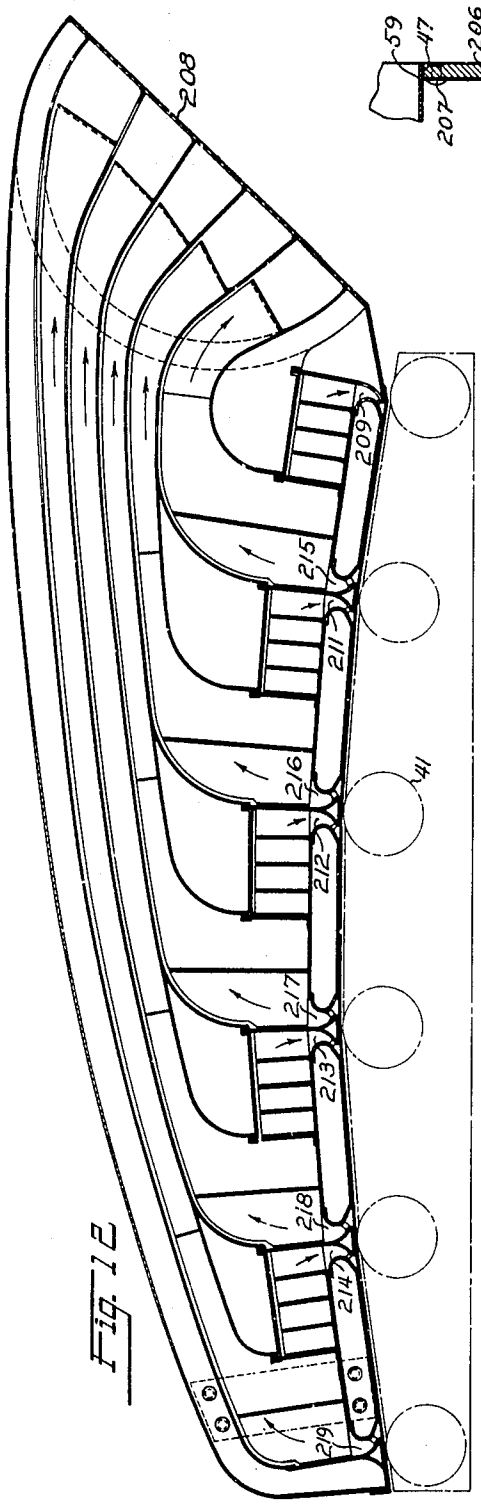


Fig. 12

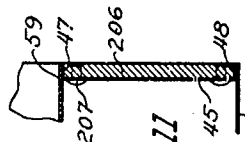


Fig. 11

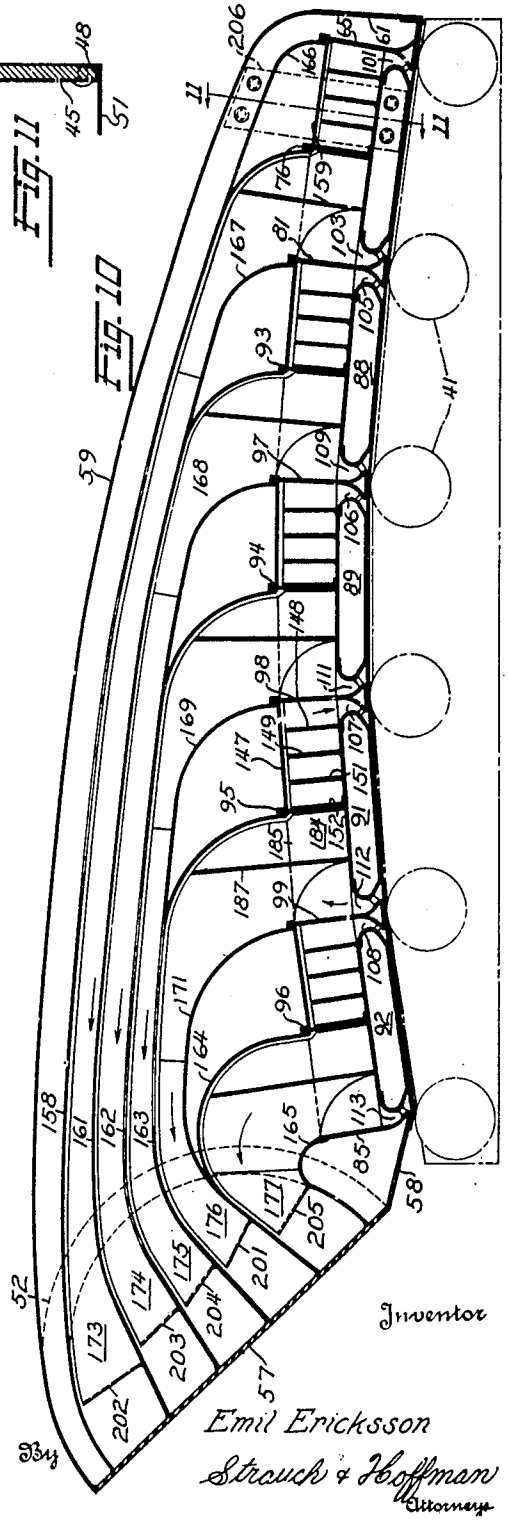


Fig. 10

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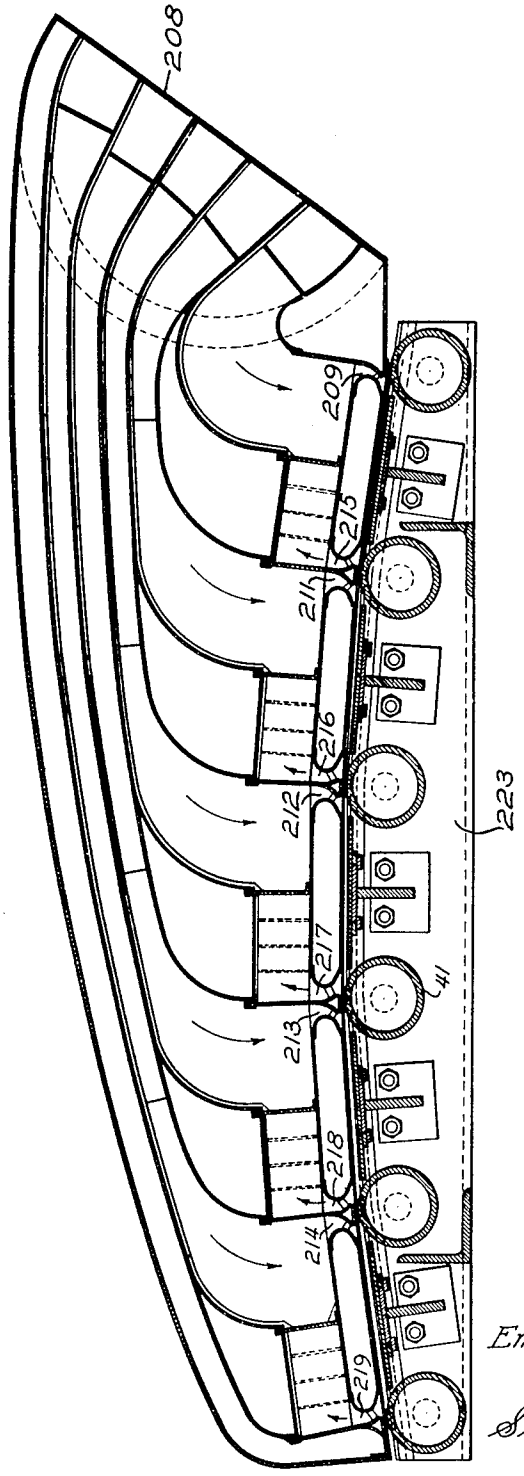


Fig. 13

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DRIER

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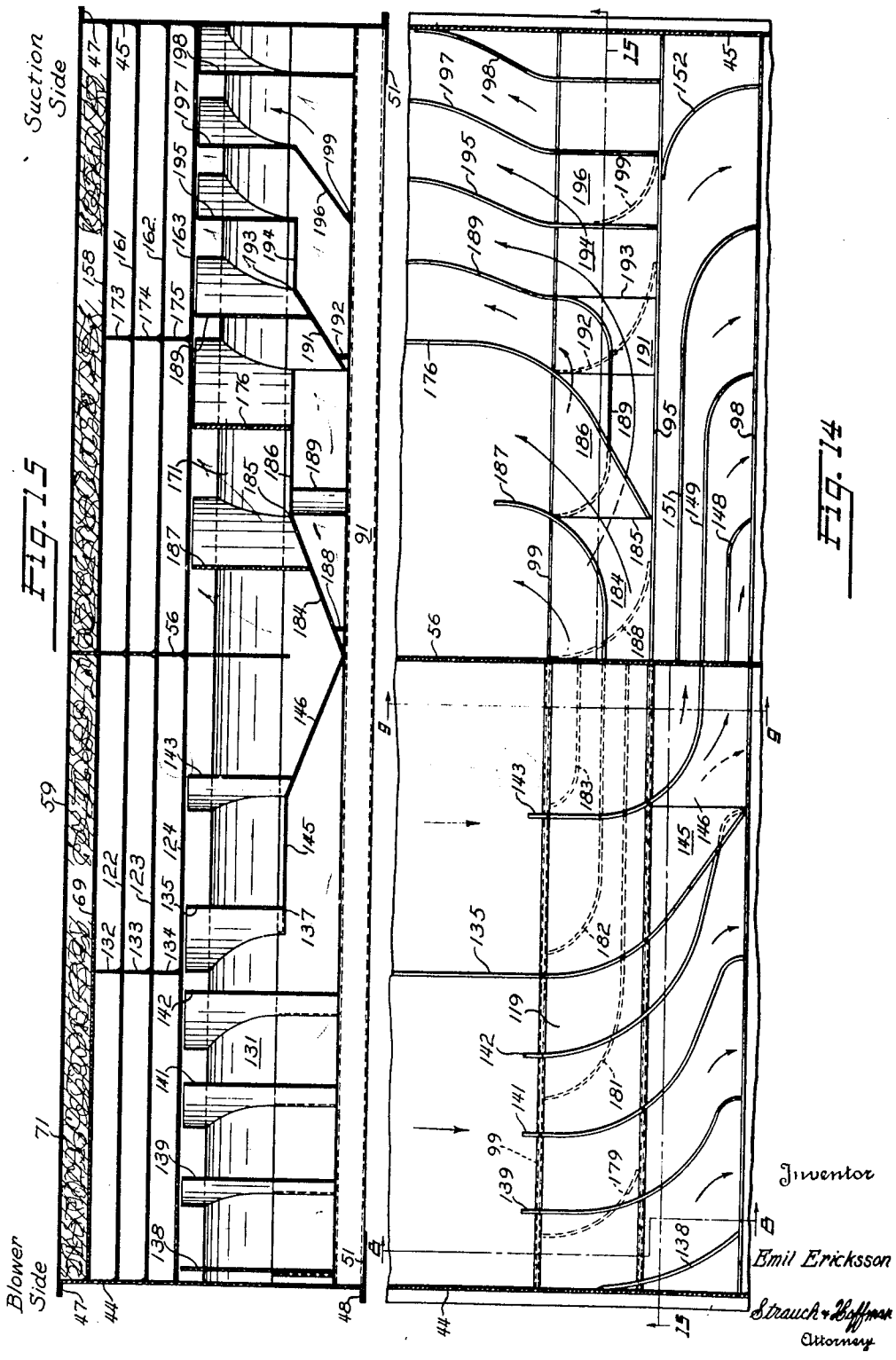


Fig. 15

Fig. 14

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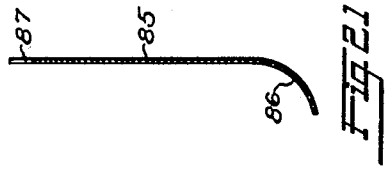


Fig. 21

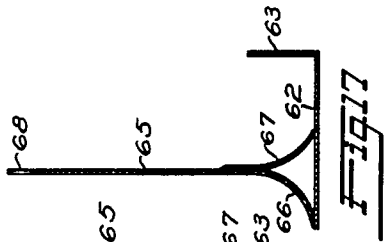


Fig. 17

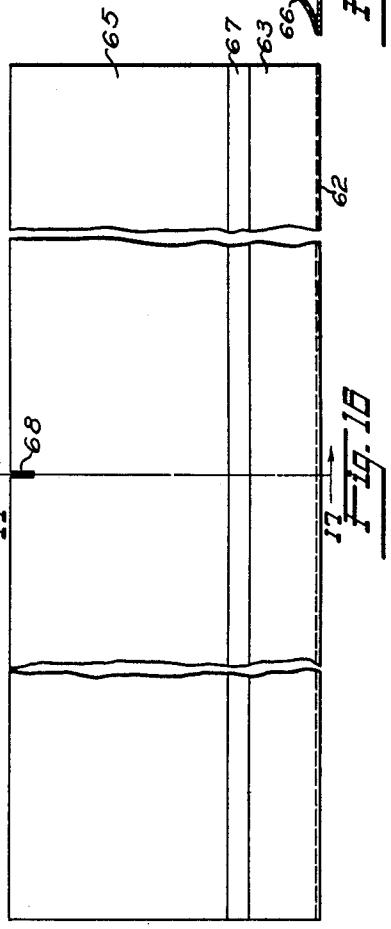


Fig. 16

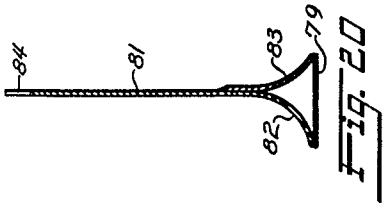


Fig. 20

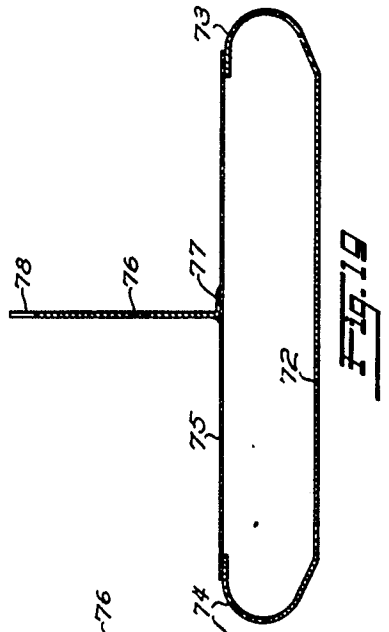


Fig. 10

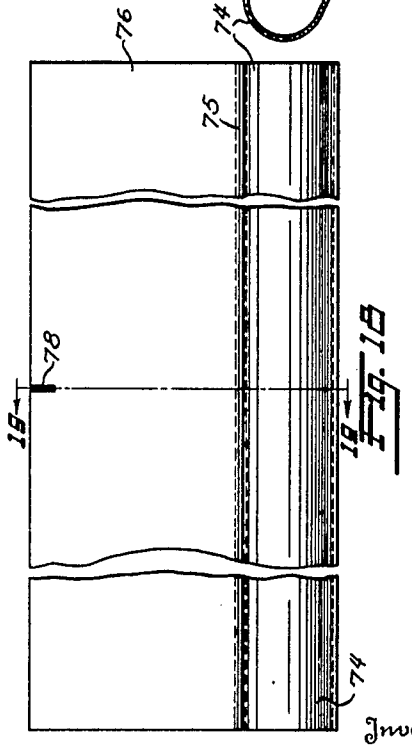


Fig. 19

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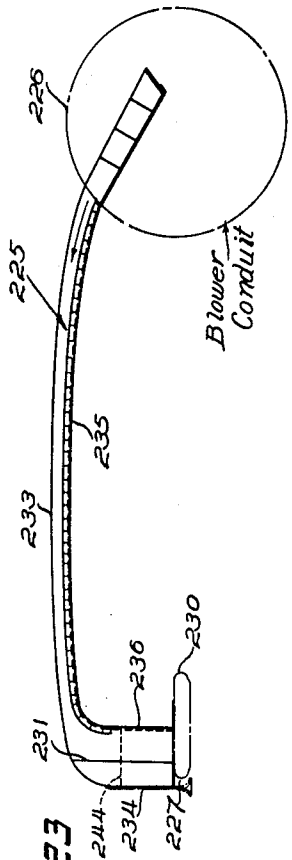


Fig. 23

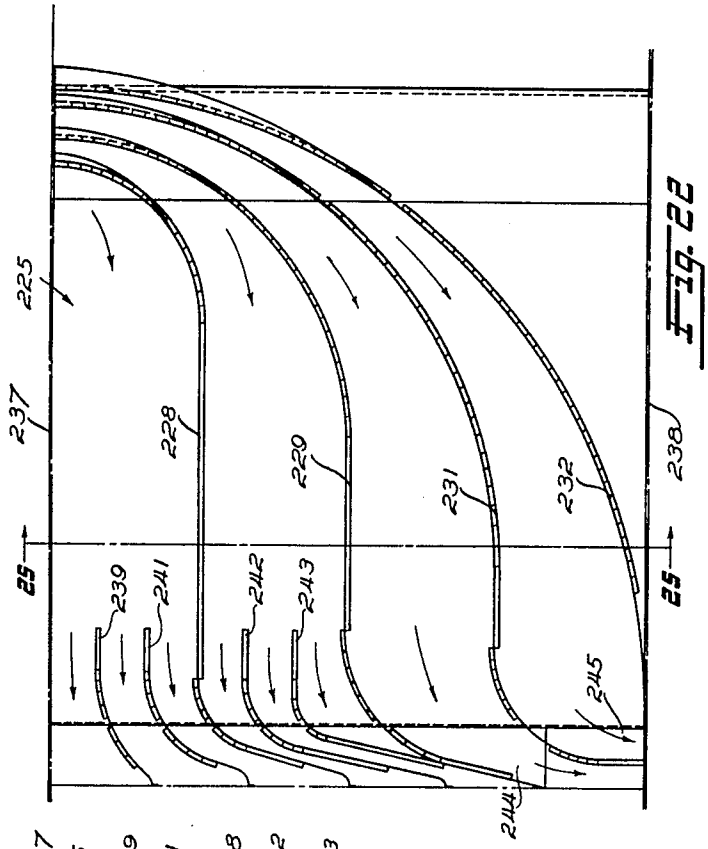


Fig. 22

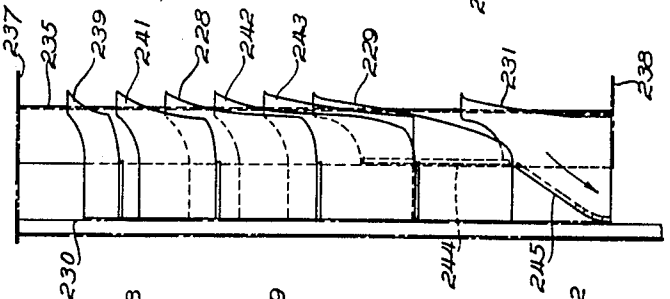


Fig. 24

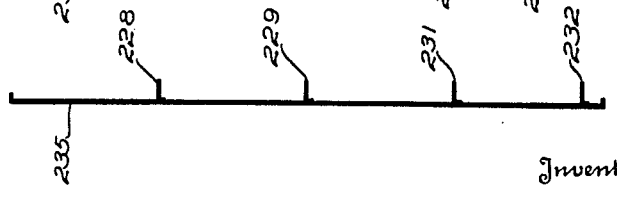


Fig. 25

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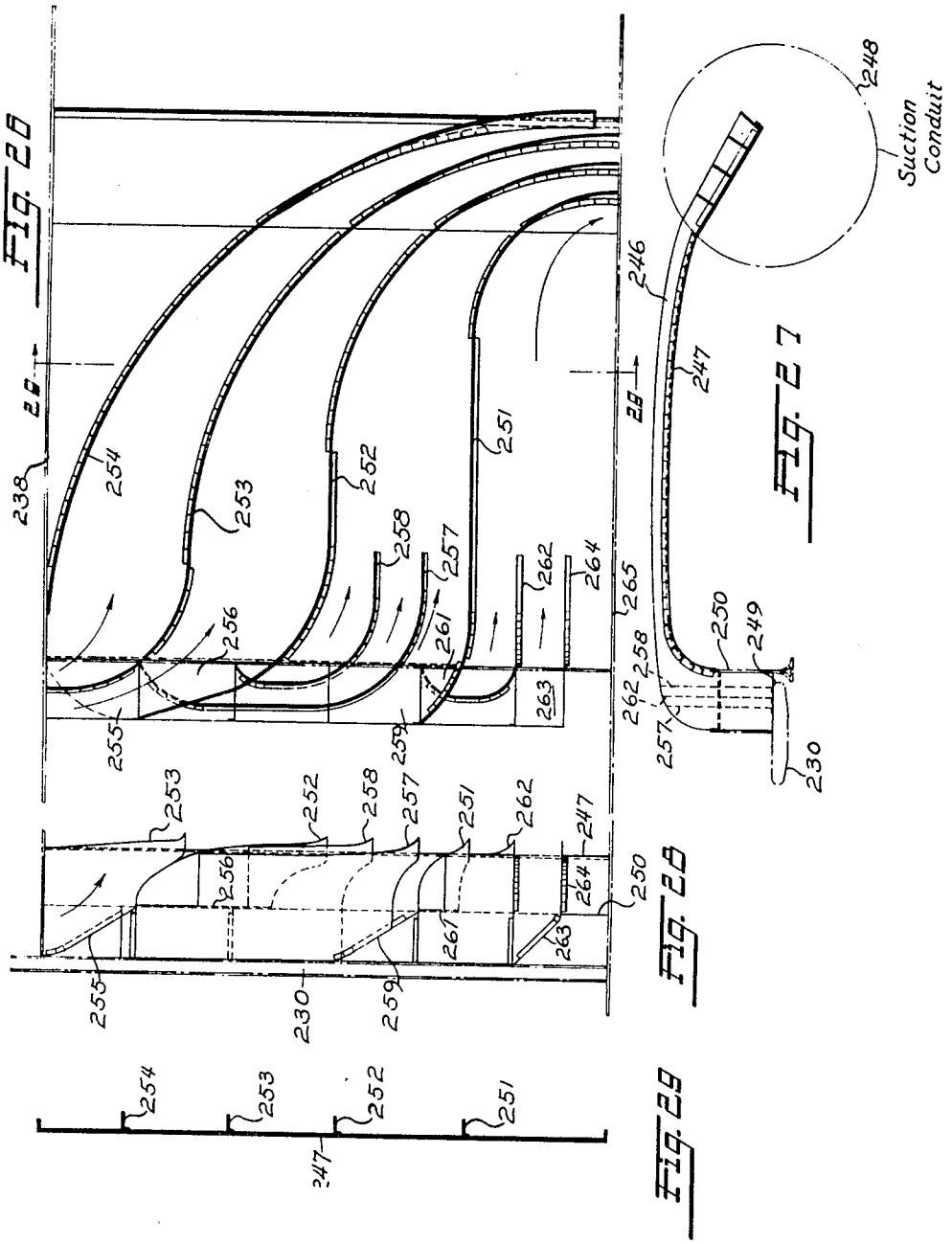
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DRIER

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Patented Oct. 19, 1943

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UNITED STATES PATENT OFFICE

2,332,067

DRIER

Emil Ericksson, Chicago, Ill., assignor to Standard Process Corporation, Chicago, Ill., a corporation of Delaware

Application July 26, 1939, Serial No. 286,678

10 Claims. (Cl. 34—160)

The present invention relates to surface treating and drying apparatus and is more particularly concerned with fluid treating apparatus for drying or similarly treating a freshly coated or printed sheet surface or the like.

In its preferred embodiment, the invention is employed for quickly drying the freshly printed surface of a high speed moving sheet or web to prepare that surface for further printing or other surface treating operation, or for stacking or packaging. The present invention is an improvement over the drying apparatus illustrated in my Patent No. 2,103,812, issued December 28, 1937, and this application is a continuation-in-part of my co-pending application Serial No. 99,671, filed September 5, 1936, which is a division of that patent and was issued May 20, 1941 as United States Letters Patent No. 2,242,995.

It is a major object of the present invention to provide novel drying apparatus for quickly drying a moving freshly printed or coated sheet surface or the like wherein that surface is subjected to the action of a drying fluid such as air under pressure which is projected on the surface and then confined therealong for a substantial distance to insure proper drying action, and wherein the drying fluid containing the entrained impurities resulting from said drying action is completely removed, as by suction, from the surface in such a manner as to insure against contamination of the atmosphere adjacent the apparatus.

A further object of the present invention is to provide a novel drier wherein drying fluid is discharged upon a moving sheet surface or the like to be dried at an acute angle against the direction of travel of the sheet and then, after being confined along the sheet surface for a substantial distance to insure proper drying action, is withdrawn at an acute angle which extends generally oppositely to the first mentioned angle. Specifically, the fluid is withdrawn by an exhaust system of such capacity as to maintain the general pressure of the fluid within the drier slightly below that of the surrounding atmosphere so as to insure that there will be no leakage of noxious fumes and vapors to the area immediately about the apparatus. The fluid is also preferably withdrawn at a much faster rate than it is supplied by the discharge system; and exhaust system is of much greater capacity than the discharge system.

A further object of the invention is to provide a novel drier wherein a plurality of alternately disposed, oppositely inclined drying fluid supply and exhaust nozzle means are arranged along a sheet surface or the like to be dried so that each portion of the surface is subjected successively to a plurality of separate and independently acting charges of circulating drying fluid. Specifically the drier comprises a series of independent units connected to drying fluid supply and exhaust lines at opposite sides of the sheet. Preferably the exhaust nozzle means is about twice as large as the supply nozzle means.

A further object of the invention is to provide a novel supporting structure over which a sheet or web to be dried is tensed in a generally convex path as it passes the drier.

A further object of the invention is to provide an insulated drier housing having novel passage and nozzle structure for applying and withdrawing drying fluid at the surface to be dried. Specifically the housing contains a plurality of alternate supply and exhaust nozzles each connected to passages in the housing, with all of the supply nozzle passages connected to a common supply conduit and all of the exhaust nozzle passages connected to a common exhaust conduit; and novel fluid directing baffle structure is provided throughout the housing for insuring proper direction and distribution of the drying and exhaust fluids.

Further objects of the invention will presently appear as the description proceeds in connection with the appended claims and the annexed drawings in which:

Figure 1 is a somewhat diagrammatic side elevation of a complete drier installation according to the invention illustrating the general relation of all the parts;

Figure 1A is a fragmentary top plan view of part one of the driers;

Figure 2 is a top plan view on a reduced scale of the apparatus of Figure 1;

Figure 3 is a side elevation of a side plate of the type employed at opposite sides of each drier looking at the inner side of the plate;

Figure 4 is an elevation of the inner end of the side plate of Figure 3;

Figure 5 is a section taken along lines 5—5 of Figure 3;

Figure 6 is a side elevation of the center plate employed in each drier section;

Figure 7 is a section taken along line 7—7 of Figure 6;

Figure 8 is a side elevation in section taken from the blower side of drier No. 2 illustrating the nozzle and baffle construction. The location of this view is indicated by line 8—8 in Figure 14;

Figure 9 is an enlarged fragmentary side elevation taken from the blower side of drier No. 2 further illustrating the nozzle and baffle construction. The location of this view is indicated by line 9—9 in Figure 14;

Figure 10 is a side elevation partly in section taken from the blower side of drier No. 2 at the center of the drier with the center plate removed illustrating further the nozzle and baffle construction;

Figure 11 is a section taken along line 11—11 of Figure 10 illustrating the hanger plate;

Figure 12 is a side elevation partly in section taken from the blower side of the drier No. 1 with the near side plate removed to illustrate the nozzle and baffle construction of the invention;

Figure 13 is a side elevation partly in section taken from the blower side of drier No. 1 with the center plate removed to further illustrate the nozzle and baffle construction at the suction side of the drier;

Figure 14 is a plan view, partly in section, of the baffle arrangements at any complete drier station;

Figure 15 is an end elevation, in section, taken along line 15—15 of Figure 14;

Figure 16 is a side elevation of an end rib unit positioned at the outer end of the drier section;

Figure 17 is a section taken along line 17—17 of Figure 16;

Figure 18 is a side elevation of the support tube employed at each drier station;

Figure 19 is a section taken through the support tube at line 19—19 of Figure 18;

Figure 20 is a section illustrating the intermediate rib units employed between the support tubes.

Figure 21 is a section illustrating the rib unit at the inner end of each drier section;

Figure 22 is a fragmentary rather diagrammatic top plan view of the baffle wall arrangements in a drying fluid supply passage at the blower side of a drier comprising a different embodiment of the invention.

Figure 23 is a diagrammatic view in side elevation of the drier of Figure 22;

Figure 24 is a diagrammatic front view of the baffle walls in the supply passage of Figure 22;

Figure 25 is a section taken along line 25—25 in Figure 22;

Figure 26 is a fragmentary rather diagrammatic top plan view of the suction passage at the suction side of the drier leading to the same drying station as the supply passage of Figure 22;

Figure 27 is a diagrammatic end elevation of the suction passage of Figure 26;

Figure 28 is a diagrammatic front elevation of the suction passage of Figure 26;

Figure 29 is a section taken along line 29—29 of Figure 26.

Referring to Figures 1, 1A and 2, the drier apparatus embodying a preferred form of the invention comprises a pair of adjacent, generally normally disposed driers labeled drier No. 1 and drier No. 2.

The web or sheet S to be dried is drawn under tension over a generally convex support beneath each drier in succession with the surface to be dried facing the driers. The driers are shaped to conform to the curvature of the web so that the lower surface of each drier is substantially parallel to and located very close to the surface to be dried. For practical purposes, a spacing of about one-eighth of an inch between the bottom surface of the drier and the surface of sheet S has been found satisfactory when drying freshly printed web surfaces with air under pressure.

Driers No. 1 and No. 2 are illustrated in Figure 2 as connected to a common exhaust or suction system at one side and a common drying fluid supply or blower system at the other side. Suitable fans or other pressure creating means may be used in these units.

The driers are open at their sides and ends above the web and, since the fumes and vapors arising from the drying surface are often poisonous, arrangements are made to insure that none escape into the room surrounding the driers. Conditioned drying fluid, preferably air which has been washed and dried, is forced under pressure from the blower system through a series of passages and nozzles, later to be described, onto the surface to be dried and then removed with its entrained vapors and fumes by a second series of nozzles and passages leading to the suction system. This insures that the drying fluid will be withdrawn from the surface to be dried at a faster rate than it is supplied, and that the general or average pressure within the space between each drier and that surface will be subatmospheric or below the pressure of air surrounding the drier. There will usually be a slight inflow of air at all outer edges of each drier thereby insuring against outward leakage of the fumes. Preferably the exhaust system, including the suction nozzles, is appreciably larger and of greater capacity than the air supply system to insure complete removal of all drying fluid, fumes and vapors arising from the drying surface and any air which might be sucked in at the drier edges.

As shown in Figure 1, the driers are preferably arranged to act successively upon the continuously moving surface to be dried. If desired, they may be used separately, or may be spaced, or employed to discharge different types of drying fluid upon the web surface. For example drier No. 1 may employ heated dry air as the drying fluid while drier No. 2 may employ relatively cool dry air. For special drying jobs, various gases may be employed. In any event the physical and chemical characteristics of the drying fluid and its manner of application, including rate of flow, depend mainly upon the speed of the surface to be dried, the nature of the coated or wetted surface to be dried, the nature of the coating material on the surface and other working conditions peculiar to the operation at hand.

Drier No. 1 is provided with opposite side plates 42 and 43 and drier No. 2 is provided with opposite side plates 44 and 45. Plate 45, illustrated at Figures 3, 4 and 5, comprises a thin sheet of metal of suitable shape covering an entire longitudinal side of drier No. 2. Plate 45 is formed with a large semi-circular recess 46 at its inner end and with short, integral, laterally outwardly projecting flanges 47 and 48 at its top and bottom edges respectively.

Bottom flange 48 is formed with a short straight angular portion 49 at its inner end and shaped over the remainder of its length to conform to the curvature of the web support. A strip of sheet metal 51, secured along the bottom of flange 48 as by spot welding projects a short distance inwardly from plate 45. Strip 51 terminates short of portion 49.

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A relatively thick semi-circular metal collar 52 is secured upon the outer lateral surface of plate 45 between flanges 47 and 48 and along the edges of recess 46 as by rivets 53. Preferably a filling of solder or other suitable material for producing an air tight joint is provided between collar 52 and the plate. Both the plate and collar are provided with a series of tapped holes 54 for attaching a suitable conduit leading to the suction system.

Plates 42, 43 and 44 are substantially the same as plate 45, except for being reversed to fit their respective drier sides, and need not be described further, and corresponding parts on the latter plates will be identified hereafter by the numerals applied to plate 45.

Driers No. 1 and No. 2 are provided with longitudinal center plates 55 and 56 respectively, which extend the full length thereof and isolate the suction and blower passages in the upper parts of the driers as will later be described.

Plate 56, as illustrated in Figures 6 and 7, is preferably a thin flat metal sheet shaped generally similarly to plate 45 but is of less depth than plate 45 to permit passage of the transverse nozzle and passage structure extending between the side plates later to be described. At its inner end, plate 56 further differs from plate 45 in that it is solid and not provided with a recess similar to that at 46. Plate 55 is identical with plate 56 and need not further be described.

Referring to Figure 8, drier No. 2 is provided with an inner end closure sheet of metal or the like 57 which is formed at its lower end with an integral inclined ledge 58. Sheet 57 extends entirely across the drier between the matched inner ends of plates 44 and 45 and bridges the inner edge of center plate 56. Ledge 58, at opposite sides of the drier, laps over the end portions 49 of plate flanges 48. Sheet 57 is preferably welded to plates 44, 45 and 56 and to flanges 48 so as to provide an air tight end closure for the drier.

The upper side of drier No. 2 is enclosed by a metal sheet 59 which extends longitudinally from the top edge of sheet 57 along the upper edge of plate 56 and curves downwardly to terminate in an outer end wall 61 whose lower edge extends over the ends of flanges 48. Sheet 59 is secured in air-tight relation, as by welding to flanges 47 on plates 44 and 45 as well as to plate 56 and sheet 57. Sheet 59, wall 61 and plates 44, 45 and 57 define the end, side and top walls of drier No. 2 and drier No. 1 is similarly fashioned.

Drying fluid supply passages—drier No. 2

A rib unit, illustrated in Figures 8, 16 and 17, comprises a generally horizontal plate 62, whose opposite ends rest on opposite plate flanges 48, having an upturned vertical flange 63 extending along the inner side of wall 61 and secured thereto by suitable fastening means such as metal screws 64. Preferably plate 62 is welded to flanges 48 and a filling of solder provided between flange 63 and wall 61 to produce air tight joints.

A generally vertical rib 65, having an inwardly curved nozzle wall 66 at its lower end, projects upwardly from plate 62. Nozzle wall 66 terminates at the inner edge of plate 62 and is secured thereto as by welding. An outwardly curved brace plate 67 extends along the other side of rib 65, being secured to both rib 65 and plate 62, as by welding.

The above described end rib unit extends entirely across the drier and rib 65 is notched at 68 to interfit with the bottom edge of center plate 56. This joint is preferably made air-tight, as by welding or soldering during assembly.

From the upper end of rib 65, a sheet of metal or the like 69, extends longitudinally of the blower side of the drier between plates 44 and 56 and generally parallel to sheet 59, and is welded or similarly secured in air tight relation at its inner edge to plate 57. The space defined by sheet 59 and wall 61 above and sheet 69, rib 65 and plate 67 below is preferably filled with a suitable heat insulating material, such as mineral wool or the like, indicated at 71.

Inwardly of rib 65, a support tube unit, illustrated in further detail in Figures 18 and 19, extends across the entire drier. The support tube unit comprises a sheet of metal or the like having a generally horizontal, flat bottom wall 72 whose opposite ends are inclined and curved upwardly and outwardly and then inwardly to provide generally cylindrical integral end walls 73 and 74. The upper ends of walls 73 and 74 are bridged by a flat top wall 75 which is secured thereto in air-tight relation as by soldering and extends generally parallel to wall 72.

Walls 72—75 define a relatively thin open ended tube whose opposite ends rest on opposed plate flanges 48 of the side plates, being secured thereto as by welding. A generally vertical rib 76, parallel to rib 65, is formed with a bottom lip 77 secured in air-tight relation as by welding along the center of top surface of wall 75.

Rib 76 is notched at 78 to interfit with the bottom edge of center plate 56 and this joint is preferably soldered to render it air-tight.

Inwardly of the support tube unit is disposed a baffle rib unit illustrated in detail at Figure 20 and comprising a generally horizontal strip 79 extending entirely across the drier; a generally vertical rib 81 identical with rib 65 and having its curved lower end 82 terminating and secured in air-tight relation as by soldering upon the inner edge of strip 79; and a curved brace plate 83 identical with plate 67 soldered or otherwise secured in air-tight relation at its opposite edges to rib 81 and the outer edge of strip 79 respectively. Rib 81 is notched at 84 to interfit with the lower edge of center plate 56 and this joint is preferably made air-tight.

At the inner end of drier No. 2 an end rib 85, illustrated in Figure 21, whose lower end 86 is curved with substantially the same curvature as plates 67 and 83, extends entirely across the drier. The lower edge of rib 85 is secured in air-tight relation as by soldering or welding to the edge of ledge 58 (Figure 8) while its upper edge is notched at 87 to interfit with center plate 56, the latter joint being soldered to render it air-tight.

Inwardly of baffle rib 81, as illustrated in Figure 8, a series of spaced support tube units indicated at 88, 89, 91 and 92 having upstanding ribs 93, 94, 95 and 96, respectively, extend transversely across the drier. These support tube units are all parallel and identical with the support tube unit above described.

A series of baffle rib units indicated at 97, 98 and 99, parallel and identical with the baffle rib unit above described and illustrated at Figure 20,

are disposed between the support tubes as illustrated in Figure 8.

The lower walls 62, 72 and 79 of the various ribs and support tubes define the lower surface of the drier and lie generally in an arcuate plane which is parallel to the path of the surface being dried. Actually, as shown in Figures 8 and 9, the web is stretched in a straight line between successive rollers 41 and each wall 72 is parallel to that line. Also the rib units are disposed above successive rollers 41 so that their upstanding rib parts such as 65, 81, 97, 98, 99, and 85 are each aligned with a diameter of the roller beneath while the flat bottom plates 62 and 79 are generally tangential to the web surface passing over the roller beneath.

The curvature of the web path is of such large radius that the above described arrangement is the practical equivalent of a continuously curved bottom surface on the drier, and the parts may be shaped or arranged to define a smoothly continuous surface, if desired.

Referring to Figure 8, walls 66 and 73 define the throat of a discharge or blower nozzle 101 which extends entirely across the web and is inclined, preferably at an acute angle of about 45 degrees to direct air or other drying fluid upon the surface to be dried and against the direction of travel of that surface.

Nozzle 101 is flared at both ends with its upper or entrance mouth appreciably larger than its discharge mouth which lies just above the surface to be dried. Nozzle 101 is entirely unobstructed except for a pair of small thin spaced plates 102 which extend between and are rigid with walls 66 and 73 at the most restricted portion of the nozzle.

Walls 74 and 83 define the throat of an exhaust of suction nozzle 103 which also extends entirely across the surface to be dried and is inclined, preferably at an acute angle of about 45 degrees, in the direction of travel of the web to pick up and exhaust the drying fluid travelling along the web surface.

Nozzle 103 is flared at both ends with its upper or exit mouth appreciably larger than its entrance mouth which lies close to the surface being dried. At its most restricted portion, nozzle 103 is substantially twice as large in cross section as nozzle 101 so that it has about twice the capacity of the latter. Nozzle 103 is entirely unobstructed except for a pair of small thin spaced plates 104 which extend between and are rigid with walls 74 and 83 at the most restricted part of the nozzle.

Similarly, as shown in Figures 8 and 9, the various support tube and baffle rib units define a series of transverse discharge nozzles 105, 106, 107 and 108 disposed along the bottom surface of the drier alternating with a series of discharge nozzles 109, 111, 112 and 113, respectively.

Plates 102 and 104 are provided in the several discharge and exhaust nozzles and are staggered transversely of the surface being dried to insure that all portions of that surface are exposed directly to the nozzles. Plates 102 and 104 also serve as structural members along with the support tubes and ribs for increasing the rigidity of the drier frame.

A flat cover plate 114 whose inverted integral generally U-shaped edge sockets 115 and 116 fit over ribs 76 and 81 extends between center plate 56 and end plate 44. A series of identical cover plates 117, 118, 119 and 121 are bridged across ribs 93 and 97, 94 and 98, 95 and 99, and 96 and 85, respectively. These cover plates comprise the top walls of the exhaust passages above the exhaust nozzles at the blower side of the drier.

At the blower side of center plate 56, a series of sheets of metal or the like 122, 123, 124, 125 and 126 extend longitudinally of the drier between plates 44 and 56 from end closure sheet 57 and curve downwardly at their outer ends to terminate in contact with the cover plate sockets fitting over ribs 81, 97, 98, 99 and 96, respectively. These sheets are preferably substantially parallel and equi-spaced during their coextensive length and are welded, soldered or otherwise secured in air-tight relation at both side and end edges.

A sheet of metal or the like 127 extends upwardly from socket 116 at the blower side and is then bent inwardly below and parallel with sheet 69 until it contacts sheet 122 to which it is secured in air tight relation. The side edges of sheet 127 are preferably welded to plates 44 and 56. Sheet 127 is so aligned with sheet 122 as to define a continuation of the bottom wall of the air supply passage leading to nozzle 101, sheet 69 defining the upper wall of that passage.

Similarly sheets 128, 129 and 131 extend upwardly from the top ends of ribs 93, 94 and 95, respectively, at the blower side and are bent inwardly below and parallel to the passage defining wall above until they contact sheets 123, 124 and 125, respectively, to which they are secured in air-tight relation. Sheets 128, 129 and 131 are similar to sheet 127 in that they define continuation of the lower walls of air supply passages leading to nozzles 105, 106 and 107, respectively.

Referring to Figure 8, a series of central baffle plates 132, 133, 134, 135 and 136 extend longitudinally of the drier along the air supply passages leading to nozzles 101, 105, 106, 107 and 108, respectively, terminating just below the top edges of the ribs on support tubes adjacent each nozzle. As shown in Figure 15, each of these plates is welded or otherwise rigidly secured to the passage wall immediately below and has its upper edge spaced slightly from the passage wall immediately above.

Referring to Figure 14, which is a plan view of the passages above nozzles 107 and 112 with passage walls 124 and 131 removed to more clearly show the longitudinal passage arrangements, plate 135 is curved inwardly at a point immediately above rib 99. The lower edge of plate 135 is indicated at 137 in Figures 8 and 15.

Referring to Figure 14, the purpose of plate 135 is to divide the air supply passage leading to nozzle 107 generally into two separate streams. The stream to the left of plate 135 is discharged through the nozzle only at the blower side of center plate 56 while the stream to the right of plate 135 is discharged through the blower nozzle only at the right of center plate 56.

Beginning at a point generally above rib 99, a series of longitudinal baffles 138, 139, 141 and 142 are provided in the air supply passage at the left of plate 135. These baffles are all preferably welded to sheet 131 and spaced from sheet 124 in the same manner as plate 135, and terminate at the top surface of support tube 91. These baffles bridge nozzle 107 at substantially equidistant points and are rigidly secured as by welding to rib 98 and tube 91.

End baffle 138 provides a smooth wall eliminating possibility of an air pocket between side plate 44 and rib 98 and preventing air from be-

ing discharged so close to the edge of the drier that it might be forced outwardly of the drier. This helps eliminate pressure leakage at the end of the blower nozzle.

Baffle 142 (Figure 14) extends below the lower edge of plate 135 and is secured to rib 98 in alignment with plate 135.

Referring to Figure 14, a baffle plate 143 which is substantially centrally disposed in the air supply passage to the right of plate 135 extends generally arcuately from a point generally above rib 99 to center plate 56 midway between ribs 98 and 95.

As illustrated in Figure 14, the lower edges of baffles 135 and 143 terminate a substantial distance above support tube 91 and are bridged by a wall 145 which extends between plate 135 and rib 98 on one side and rib 98 at the other side toward the center of the drier. Wall 145 comprises a generally horizontal portion and a downwardly inclined portion 146 which terminates adjacent the top wall of tube 91 in vertical alignment with center plate 56. Thus the fluid streams between plate 135 and center plate 56 are directed generally laterally of the drier and beneath center plate 56 to the suction side of the drier as indicated by the arrows in Figure 14.

A cover plate 147 illustrated in Figure 10, but omitted in Figure 14, bridges ribs 95 and 98 at the suction side of the drier and extends between center plate 56 and side plate 45. Below cover plate 147, a series of equi-spaced baffles 148, 149 and 151 extend parallel to rib 95 from just below center plate 56 and each plate is curved into contact with rib 98 at equi-spaced points. Baffles 148, 149 and 151 are secured, as by welding, upon the top wall of tube 91 and to rib 98; and the top edges of these baffles are spaced slightly below plate 147 as shown in Figure 10.

The end baffle at the suction side of the drier comprises a curved plate 152 generally parallel to the curved end of baffle 151 and extending between ribs 95 and 98. Baffle 152 is so designed as to eliminate as much as possible any tendency of the air to be forced toward plate 45 and is spaced a substantial distance interiorly of plate 45. The upper edge of baffle 152 may be welded to the bottom of cover plate 147 to guard against leakage if desired.

Referring to Figure 8, a baffle wall 152 is secured upon one edge, as by welding, upon sheet 122 and its top edge is spaced slightly below sheet 69. Baffle 153 projects from the blower side edge of sheet 122 to the end of plate 132 so as to divide the air incoming from the supply line substantially into two equal streams and insure uniform distribution thereof in the passage leading to nozzle 101. Similar transverse baffles 154, 155, 156 and 157 are secured within the air supply passages below, as illustrated in Figure 8.

Exhaust passages

Referring to Figures 10 and 15, a sheet of thin metal or the like 158 extends from plate 57 between plates 56 and 45, and at suction side of the drier, longitudinally to the top end of rib 76 where it is secured as by welding to the edge of cover plate 159 and rib 76. Similarly a series of spaced sheets 161, 162, 163, 164 and 165 extend longitudinally from plate 57 and are curved downwardly to be secured in air-tight relation at the top edges of ribs 93, 94, 95, 96 and 85, respectively at the suction side of the drier, These sheets are generally parallel to each other during their coextensive lengths and are preferably disposed at the same level as the corresponding blower passage defining sheets at the opposite side of the center plate 56 as shown in Figure 15.

Referring to Figure 10, a curved sheet 166 extends between plates 45 and 56 upwardly from the top edge of rib 65 and inwardly to contact sheet 158 to which it is secured as by welding. The space between sheets 59 and 158 is preferably filled with an insulating material such as mineral wool or the like.

Similarly, sheets 167, 168, 169 and 171 extend, between plates 56 and 45, upwardly and inwardly from ribs 81, 97, 98 and 99, respectively, to sheets 161, 162, 163 and 164, respectively to which they are secured as by welding.

Referring to Figures 10 and 15, a series of central baffle plates 173, 174, 175, 176 and 177 extend longitudinally within the exhaust passages leading to nozzles 103, 109, 111, 112, and 113, respectively. Each of these central baffle plates is rigidly secured as by welding to the bottom wall of the suction passage through which it extends and is slightly spaced from the top wall of that passage. Each central baffle plate terminates adjacent the top edges of the ribs and the lower edge of plate 176 is indicated at 178.

Referring to Figures 8, 9 and 14, a series of baffle plates 179, 181, 182 and 183 bridge exhaust nozzle 112 at substantially equi-spaced points. These plates are rigidly supported as by welding upon the top wall of tube 91 beneath cover plate 119. Baffle 179 is spaced a substantial distance inwardly of the side of the drier, and extends between ribs 95 and 99 and may be extended upwardly to cover plate 119 if desired to prevent leakage. Baffles 181, 182 and 183 are substantially parallel and equi-distant over their coextensive lengths with their top edges spaced below cover plate 119, and they terminate just below center plate 56. These baffles define distinct passages for removing the drying fluid at spaced points along the exhaust nozzle at the blower side and leading it to the exhaust side of the drier where, after passing under center plate 56, it flows upwardly along an inclined plate 184 (Figure 15) and into a passage whose sides are defined by center plate 56 and central baffle plate 176.

Plate 184 is bent at 185 to provide a generally horizontal conduit bottom wall 186 whose free edges are secured as by welding to the bottom edge of plate 176 and the top edge of rib 99 so that exhausting fluid from the blower side cannot escape laterally beyond plate 176 and is directed inwardly toward the suction outlet as indicated by the arrows.

A baffle plate 187, which may be integral with baffle 182, extends from beneath center plate 56 along the upper surface of plate 184 and is curved generally parallel to plate 176. Plate 187 terminates just beyond rib 99 as shown in Figure 14.

A plate 188 bridges the exhaust nozzle below plate 56 and curves laterally outwardly to rib 95 defining an arcuate inner end wall for the suction passage below plate 184. Plate 188 is preferably welded or otherwise made air-tight at all its edges.

Just below bend 185, a baffle plate 189 bridges the exhaust nozzle and extends laterally between the bottom surface of wall 186 and the top wall of tube 91. After passing beneath plate 176, plate 189 travels up the inclined passage wall 191 and then curves inwardly and longitudinally of

the drier projecting beyond the top edge of rib 99 as shown in Figure 14.

A baffle plate 192, similar to plate 188, bridges nozzle 112 and extends from rib 99 immediately below plate 176 and extends laterally outwardly to rib 95. Plate 192 is rigidly secured to tube 91 at its bottom edge and its top edge lies along the bottom surface of wall 191 which is bent at 193 to provide a generally horizontal passage wall 194 level with the top of rib 99.

The laterally outer edge of wall 194 terminates in contact with a longitudinal baffle plate 195 which extends from rib 95 upwardly and inwardly of the drier generally parallel to plate 189 as illustrated in Figures 14 and 15.

An inclined wall 196 extends upwardly from tube 91 to the lower edge of a longitudinal baffle plate 197 which bridges the top of ribs 95 and 99 and extends generally parallel to plate 189. Beyond plate 197, but spaced a substantial distance inwardly of the side of the drier, an end baffle plate 198 bridges the exhaust nozzle and extends upwardly and longitudinally parallel to plate 197 until it contacts the inner side of plate 45 to which it is rigidly secured preferably by welding. To the bottom of wall 196 is secured an arcuate baffle plate 199 extending between plate 195 and rib 95 for directing flow of fluid emerging at the end of nozzle 103.

If desired, plates 189, 195 and 191 may terminate at substantially any point longitudinally of the drier, but preferably they extend substantially coextensively with plate 176 and terminate just short of the transverse passage wall 201 which extends from the inner end of plate 176 to the exhaust line.

Similar walls 202, 203, 204 and 205 are provided at the inner ends of longitudinal plates 173, 174, 175 and 177, respectively.

Figure 11 illustrates a hanger plate 206 shaped to fit snugly on the outer side of plate 45 between the overhanging flanges 47 and 48, being rigidly secured to plate 45 as by rivets 207. One of these plates 206 is employed at each side at the outer end of the drier for supporting the drier as will later be described.

The above described drying fluid supply and exhaust passages are substantially identical at each drying station along the drier.

Drier No. 1

As illustrated in Figures 12 and 13, drier No. 1 is substantially identical with drier No. 2 above described and is supported with its inner end sheet 208 substantially flush with end sheet 57 of drier No. 2 (see Figure 1).

Drier No. 1 is provided with a series of transverse drying fluid discharge nozzles 209, 211, 212, 213 and 214 and an alternate series of exhaust nozzles 215, 216, 217, 218 and 219 which are preferably identical with the corresponding nozzles of drier No. 2. Further, the drying fluid supply and exhaust passages and the baffle arrangements therein employed in drier No. 1 are substantially identical as those above described in detail at drier No. 2 and it is believed that further detailed description of the same is unnecessary.

With the driers assembled as illustrated in Figures 1 and 2, the semi-circular collars 52 upon corresponding side plates define generally cylindrical attaching means to which suitable conduits 221 and 222 leading to the blower and suction systems, respectively, may be secured.

The driers are assembled so as to extend generally at right angles as illustrated in Figure 1. Preferably, however, the arcuate bottom surfaces of driers No. 1 and No. 2 are so inclined with respect to one another that they enclose an angle somewhat less than ninety degrees. In practice, the assemblage is such that a horizontal and vertical plane passing through the centerline of the supply and exhaust conduits will be generally tangent to the web surface adjacent the outermost ends of the driers.

Web and drier supports

Beneath each drier the web is drawn under tension over a series of rollers 41 as explained above. Referring to Figures 8 and 9, rollers 41 have their opposite ends journaled in heavy longitudinal frame members 223 which are rigidly interconnected by spaced angles 224. Frame members 223 are preferably rigid with a suitable heavy machine base (not shown). Rollers 41 may be idly mounted, or may be driven substantially at the web speed to reduce friction as desired.

A roller 41 is provided in alignment with each transverse rib of the drier above, and the bottom surface of the drier immediately above each roller is preferably substantially tangent thereto. In this manner, the web is positively backed opposite each supply and exhaust nozzle.

Between each roller 41 is located a flat surfaced table element 225 which is rigidly secured in a suitable manner upon a generally T-shaped transverse support 226. Each support 226 is rigidly secured at opposite ends to brackets 227 which in turn are attached as by bolts 228 to frame members 223.

Each element 225 extends entirely transversely of the bottom surface of the drier and its top surface lies in a plane which is parallel to the bottom wall 72 of the support tube immediately above but spaced slightly below the path of the tensed web so as not to create a friction drag thereupon. If desired, elements 225 could be formed as an integral table having transverse slots for rollers 41.

The axes of rollers 41 lie in a generally arcuate plane which is parallel to the bottom surface of the drier above. Rollers 41 are all preferably of the same size so that a web tensed therealong will also lie in a plane generally parallel to the bottom surface of the drier. By tensing the web over a convex path as above described and thereby preventing flapping of the web as it is subjected to drying fluid blowing and suction operations, it is possible to locate the drier nozzles extremely close to the web surface to be dried and thereby secure the best possible drying action. In practice, it has been found that the nozzles of the drier can be approached to about one-eighth of an inch of a freshly printed moving web surface with highly beneficial quick drying results.

If desired, the convex web supporting surface may be defined by a continuous solid surface such as the large radius impression drum of my above mentioned patent or a series of rollers of different diameter without departing from the spirit of the invention. In any event the drier nozzles and the bottom surface of the drier will be arranged and shaped in accordance with the convexity of the web or sheet path.

The convex support arrangement above described is preferably duplicated between each of driers No. 1 and No. 2, and both supports made rigid with the same heavy base.

The drier housing may be supported over the web by suitable rigid braces (not shown) extending between hanger plates 206 and frame

members 223 so as to maintain the nozzles and the web to be dried in fixed spaced relation, or may be suspended above the web support as desired.

Operation

After the web S has been treated, coated or printed as by the printing apparatus disclosed in my above mentioned patent, it is led upwardly over the substantially vertical bank of rollers 41 beneath drier No. 1 and then substantially horizontally over the arcuate bank of rollers 41 beneath drier No. 2 as illustrated in Figure 1. After passing drier No. 2, the web is further treated or rewound on a suitable reel as desired. At all times the web is maintained under sufficient tension closely along the rollers 41 to keep it from flapping or being distorted in any manner, so that the printed surface will not wipe against the lower part surface of the drier and thereby blur the printing.

The speed with which web S is led through the drier depends mainly upon the nature of the web surface and the material thereon to be dried or otherwise treated.

Driers No. 1 and No. 2 treat the web in quick succession and in substantially identical manner. Referring to Figures 1 and 2, air or some other suitable drying fluid is introduced under pressure from the blower system through conduit 221 into each of driers No. 1 and 2 simultaneously. Air from the conduit travelling to the left of sheet 208 is distributed through drier No. 1, while air travelling to the right of sheet 57 is distributed through drier 2. Sheets 57 and 208 are preferably so close together that there is no appreciable passage of air therebetween and the space therebetween may be made air tight.

As shown in Figures 8, 14 and 15, the incoming drying fluid at the right of sheet 57 in drier No. 2 is distributed among a series of vertically spaced longitudinal passages each of which extend half the width of the drier at the blower side and terminate in an inclined discharge nozzle disposed above the surface of the paper to be dried.

Each of these discharge nozzles 101, 105, 106, 107 and 108 extends entirely across the drier so as to traverse the surface to be dried and direct upon it a substantially flat stream of drying fluid at a selected angle.

Between the air supply conduit inlet and each discharge nozzle, the incoming drying fluid is directed and distributed in such a manner as to provide substantially uniform flow and equal pressure all along the discharge nozzle. The incoming stream is first split up into two separate streams by longitudinal baffles such as those at 132, 133, 134 and 135 in Figure 15. Referring to Figure 14, which is representative of the baffle arrangements at any complete drier station, all of the incoming drying fluid to the left of plate 135 is directed to that portion of the discharge nozzle 107 which is to the left of center plate 56. As the drying fluid passes outwardly and downwardly over wall 131, see Figure 8, it is split into four separate streams by the baffles 139, 141 and 142 (Figure 14). These baffles lead those four separate streams to four transversely spaced areas along the nozzle 107 at the blower side of the drier thereby discharging the drying fluid at four equally spaced areas along the web at the blower side of the drier.

Referring to Figures 14 and 15, all of the drying fluid to the right of plate 135 is divided into two separate streams by the baffle 143 and directed beneath center plate 56. After passing plate 56 these two streams are split further into four separate streams by baffles 148, 149 and 151 which discharge at four equally spaced transverse areas along discharge nozzle 107 at the suction side of the drier.

The drying fluid between baffles 135 and 143 travels beyond sheet 131 over the substantially horizontal passage floor 145 and then downwardly along the inclined wall 146 to pass beneath the center plate 56 into the discharge passages below cover plate 147 (Figure 10). Drying fluid to the right of baffle 143 passes over sheet 131 and down inclined wall 146 to pass beneath the center plate and into the two inner discharge passages below the cover plate 147.

The above described baffle and passage arrangements insure that substantially equally amounts of air at the same pressure and flow velocity are delivered at equally spaced areas along the discharge nozzle 107. The arrangement of the passage walls insures against any appreciable flow substantially transversely of the surface being dried and insures the discharge of a substantially solid sheet of air at each nozzle. Care is taken in shaping the end baffles for each nozzle, that the air be discharged downwardly at each end of the nozzle in such a manner that there is no tendency for it to blow outwardly beneath the side edges of the drier.

Referring again to Figure 8, incoming drying fluid is discharged at a suitable acute angle inclined against the direction of travel of the web and at a high rate of speed. In practice it has been found that the angle of inclination of the nozzle should be approximately 45 degrees for best results in drying freshly printed surfaces with dry conditioned air. The above described staggering of blocks 102 and 104 in the various nozzles insures that no section of the web escapes the full force of an incoming blast.

As above described, the surface of the web to be dried is only about one-eighth of an inch from the mouth of nozzle 107 or the bottom wall of the support tube. The incoming blast of air through nozzle 107 is directed upon the surface to be dried and then confined between the surface to be dried and the lower wall 72 of the support tube for a substantial distance before reaching the exhaust nozzle 112. In a practical embodiment of the invention for drying freshly printed colored ink, it has been found advantageous to provide a stream of air moving along the surface of the web for about five inches of the length of the web.

Discharge of air under appreciable pressure through nozzle 107 may tend to bow or depress the stretch of web between adjacent rollers 41. Appreciable deformation of the web by this incoming blast is halted and prevented by backing plate 225 which is disposed only about an eighth of an inch below the web so that even when the web is blown flat against said backing plate it is never disposed at a distance of more than a quarter of an inch away from the lower surface of the drier.

The speed at which the stream of air is advanced along the surface of the web against its direction of travel is mainly dependent upon the nature of the printing or other coating on the surface of the web, the speed of the web, the nature of the surface of the web and other factors depending upon the particular job at hand.

As it passes closely along the web surface, the stream of drying fluid picks up impurities includ-

ing fumes and vapors arising from the drying web surface, and is then substantially completely withdrawn from the surface of the web through the discharge nozzle 112, which extends substantially entirely across the web, coextensive with nozzle 107. Nozzle 112 is preferably about twice the cross sectional area of nozzle 107, and in the practical embodiment above mentioned it has been found advantageous to employ an exhaust nozzle about one quarter of an inch in width and a discharge nozzle about one eighth of an inch in width. For best results, nozzle 112 is preferably inclined oppositely to nozzle 107, in the direction of travel of the web and at about the same angle as nozzle 107.

All of the drying fluid which has been discharged through nozzle 107 at the blower side of center plate 56 is withdrawn from the surface of the web into a series of exhaust passages defined by baffle sheets 179, 181, 182 and 183 beneath cover plate 119 (Figures 8, 9 and 14) and are led transversely of the drier to be discharged to a suction passage to the left of central baffle plate 176 at the suction side of the drier. After passing under central plate 56, the exhausted drying fluid from the blower side of nozzle 112 travels upwardly over wall 184 in two separate streams defined by baffle 187 and then longitudinally along the drier toward the exhaust conduit.

All of the drying fluid discharged by nozzle 107 at the exhaust side of the drier is exhausted through longitudinal passages at the right of plate 176, as shown by arrows indicating the flow of fluid (Figures 14 and 15). For example, the drying fluid arising through exhaust nozzle 112, immediately adjacent center plate 56 and on the suction side of the drier, is directed laterally beneath floors 184 and 186 and then upwardly along wall 191 over wall 194 into the longitudinal passage defined between baffles 189 and 195 as indicated by the arrows.

As shown in Figure 10, the fluid from each discharge nozzle is eventually, after passing through the baffle system above described, drawn into a series of superposed longitudinal passages, one for each exhaust nozzle, and led to the exhaust conduit 222 at the suction side of the drier.

Besides being of double the capacity of the discharge nozzles, the exhaust nozzles are connected to a source of vacuum as explained above. In apparatus for drying fresh printing ink on a paper web surface, it has been found advantageous to maintain a positive pressure of about four inches of water upon the incoming drying fluid and a negative pressure of about five inches of water at the exhaust side. This insures complete removal of all the fumes and vapors arising from the surface of the drying material on the surface of the web and this removal takes place at a much greater rate than air is supplied through discharge nozzle 107 and by leakage at the edges of the drier.

It will be observed that each discharge nozzle cooperates with a preceding exhaust nozzle to provide a complete and independent drier station for subjecting each portion of the web surface to a complete and independent drying operation as it passes therebeneath. The effect of passing the web under driers of the invention is therefore to subject each portion of the web surface to the action of a series of separate and independent drying stations, each of which discharges a quantity of air upon the web surface and then withdraw it before the surface is subjected to the action of the next drying station. Any desired number of these drying stations may be employed in a drier.

The pairs of discharge and exhaust nozzles are so arranged that the final nozzles to act on the web surface before it leaves each drier will be a discharge nozzle which directs the drying fluid inwardly of the end of the drier, thereby further assuring against leakage at the edges of the drier.

The nozzle arrangements in drier No. 1 are substantially identical with those above described in drier No. 2, and the operation of drier No. 1 is therefore substantially the same as drier No. 2, except that exhaust nozzle 219 at the lower end of drier No. 1 is the first to be traversed by the web surface.

While the illustrated preferred embodiment of the invention employs two adjacent driers which act on the paper in rapid succession, it is within the scope of the invention to use a single drier, or more than two, acting upon the surface in any desired sequence. In each drier, however, the essential features of the invention are the same. Each longitudinal section of the moving web surface to be dried is subjected to a series of blasts of drying fluid which are closely confined along the web surface for a substantial distance and then are immediately withdrawn to make ready for the succeeding drying operation at the next station. During the whole operation the web is tensed upon a convex surface or support in such a manner that it does not flap or come in contact with the bottom surface of the drier and the backing plates above described maintain the surface in position to receive the full benefit of the drying blast even when high nozzle discharge velocities are employed. Where heated or cooled drying fluid is employed the layer of mineral wool at 71 provides effective insulation for maintaining the fluid at a desired temperature.

The above described baffle arrangements insure proper distribution of the fluid within the drier passages and the purpose of the slight spacing at the top edges of these baffles is to insure substantial equalization of pressure between adjacent passages. This insures a uniform flow of fluid in each passage and prevents the building up of objectionable cross currents or low pressure areas in the passages or at the discharge nozzles.

Modifications

Figures 22 through 25 and 26 through 29 illustrate diagrammatically fluid passage and baffle arrangements of a modified form of drier at the blower side and the suction side, respectively. In these figures, only the passage leading to the nozzle at the extreme outer end of the drier is illustrated.

Referring to Figure 23, a longitudinal drying fluid supply passage 225 extends from an air supply connection generally designated at 226 to a discharge nozzle designated at 227. As shown in Figure 22, passage 225 contains a series of longitudinally extending walls 228, 229, 231 and 232 which lead from the blower conduit 226 to the discharge nozzle above the web to be dried. The upper wall 233 of passage 225 is a continuous thin sheet of metal or the like extending from conduit 226 to the transverse rib 234 directly above the discharge nozzle. The lower wall 235 of passage 225 extends substantially parallel to wall 233 terminating at the top edge of the rib 236 of the support tube 230, one

of whose end walls comprises a side of nozzle 227. Side walls of passage 225 are defined by the drier side wall 237 and the drier center plate 238.

As shown in Figure 22, the air stream between side wall plate 237 and baffle 228 is divided into three separate streams by the shorter longitudinal baffles 239 and 241 which, along with sheet 228, extend longitudinally and downwardly to bridge the discharge nozzle 227.

The drying fluid entering between the baffles 228 and 229 is further split into three separate streams by shorter baffles 242 and 243 which extend longitudinally, outwardly and downwardly toward the discharge nozzle 227. Baffle 242 bridges the discharge nozzle at its lower end, while baffle 243 is curved to merge with the inner end of the wall of baffle 229. (Figure 22.)

The drying fluid between baffles 229 and 231 is directed over a substantially horizontal wall 244 and then downwardly over inclined wall 245 so as to pass below the bottom edge of center plate 238. Similarly, the fluid between baffles 231 and 232 is directed over wall 245 where, along with the fluid between baffles 231 and 229, it is led beneath the suction passages of Figure 26 and discharged at spaced points along nozzle 227 at the exhaust side of the drier. Any suitable passages for distributing the fluid along the nozzle 227 at the suction side of the drier, such as those above described in Figures 1 through 20, may be provided.

All of the fluid at the left of wall 229 in Figure 22 is discharged through nozzle 227 at the blower side of the drier, while all of the fluid at the right of wall 229 is discharged through nozzle 227 at the exhaust side of the drier.

The suction passage 246 illustrated in Figure 27 is disposed on the same level within the drier as the blower passage 225 in Figure 23. The lower wall 247 of passage 246 extends from suction connection 248 longitudinally of the drier to the top of the rib 250 adjacent discharge nozzle 249.

Referring to Figure 26 a series of longitudinally extending passage walls extend along passage 246 from the exhaust conduit connection toward the discharge nozzle. These walls 251, 252, 253 and 254 define a series of suction conduits which extend substantially the whole length of passage 246.

The exhausted drying fluid, bearing the impurities drawn from that portion of the discharge nozzle 249 which lies at the blower side of central plate 238, is directed beneath the central plate into the passages defined by baffles 254, 253 and 252 and thereby conducted to the suction conduit 248. All of the exhausted fluid from the blower side of nozzle 249 is exhausted to the left of wall 252 in Figure 26.

As shown in Figure 28, the lower wall 255 of baffle 253 is inclined to permit flow of the fluid from the suction nozzle therebeneath, and to direct drying fluid from the blower side of the drier upwardly into passage 246. The passage between baffles 253 and 252 is also provided with a horizontal floor 256 which may be integral with inclined wall 255.

A pair of baffle walls 257 and 258 begin at spaced points along the exhaust nozzle beneath wall 256, and extend laterally and upwardly to terminate within passage 246 between baffles 251 and 252. Baffle 257 is provided with an inclined bottom wall 259 which terminates in a horizontal wall 261. Wall 262 extends from beneath wall 261 laterally upwardly into passage 246 adjacent baffle plate 251. Finally, a passage wall 264 having an inclined portion 263 extends laterally from the top surface of the support tube and is then turned on edge to travel inwardly for a substantial distance within the space between wall 262 and the side wall 265 of the drier at the suction side.

In operation, fluid entering from discharge conduit 226 is led along the various passages and baffles to discharge at nozzle 227 a substantially solid stream of air or other drying fluid upon the web to be dried. This fluid travels closely along the surface to be dried and is then exhausted through nozzle 249 into the suction passage 246.

Other than the specific passage arrangements above described both embodiments of the invention are substantially identical and the operation is the same. In the embodiment illustrated in Figures 22—29, the fluid is subdivided into a larger number of streams than in Figures 1—21, and such is more desirable where extremely high pressures are used at the discharge system.

The web support means and the other features described above in Figures 1 to 21 can be used with the modification of Figures 22 to 29 without material change.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In apparatus for drying a moving sheet or web surface, means defining a predetermined path over which said sheet or web is passed, a housing, longitudinally spaced transverse drying fluid discharge and exhaust nozzles extending substantially entirely across one side of the housing, said discharge and exhaust nozzles being alternately disposed along said path, and means defining transversely spaced groups of longitudinal drying fluid supply and exhaust passages individually connected to the respective nozzles extending in side by side relation within said housing, each of said passages being laterally enlarged at the nozzle end to open to its associated nozzle substantially entirely along the latter.

2. In the drying apparatus defined in claim 1, a plurality of uniform flow producing longitudinal baffle plates within each of said passages terminating at spaced points along said nozzles.

3. In apparatus for drying a moving sheet or web surface, means defining a predetermined path over which said sheet or web is passed, a housing, spaced transverse drying fluid discharge and exhaust nozzles extending substantially entirely across one side of said housing, said discharge and exhaust nozzles being alternately disposed along said path, and means defining transversely spaced groups of drying fluid supply and exhaust passages extending in side by side relation longitudinally within said housing, each of said groups comprising a plurality of passages individually connected to said nozzles and arranged at different levels within said housing and each of said passages being open to its asso-

ciated nozzle substantially entirely along the latter.

4. In apparatus for drying a moving sheet or web surface, means defining a predetermined path over which said sheet or web is passed, a housing, transverse drying fluid discharge and exhaust nozzles extending substantially entirely across the bottom of said housing, said discharge and exhaust nozzles being alternately disposed along said path, a generally vertical longitudinal division wall within said housing above said nozzles, a plurality of spaced walls within said housing at one side of said division wall defining a plurality of fluid supply passages at different levels and a plurality of spaced walls within the housing at the opposite side of said division wall defining a plurality of fluid exhaust passages at different levels, each of said passages being laterally enlarged at the outer end to open to an associated nozzle substantially entirely along the latter.

5. In the apparatus defined in claim 4, said division wall being an upright plate located centrally within said housing.

6. In apparatus for drying a moving sheet or web surface, means defining a predetermined path over which said sheet or web is passed, a source of drying fluid, an exhaust means, a drier housing supported closely adjacent said path having a wall extending adjacent said path, means within the housing providing a pair of transversely spaced groups of longitudinal passages, means connecting one group of said passages to said source of drying fluid and means connecting the other group of said passages to said exhaust means, a plurality of alternate drying fluid discharge and exhaust nozzles at said wall of said housing adjacent said path, said nozzles being substantially parallel and transverse to said path and spaced longitudinally along said path, means connecting the passages of said one group to said discharge nozzles, and means connecting the passages of said other group to said exhaust nozzles.

7. Apparatus for drying a moving sheet or web comprising means defining a predetermined path over which said sheet or web is passed, a housing having a wall adjacent said path and a longitudinal division plate, spaced walls providing a plurality of longitudinal drying fluid supply passages within said housing at one side of the plate and a plurality of longitudinal exhaust passages within said housing at the other side of said plate, a plurality of alternately disposed discharge and exhaust nozzles extending transversely of the wall of said housing adjacent said path, means for leading drying fluid from said supply passages to spaced portions of the discharge nozzles beneath said exhaust passages and means for leading said fluid away from spaced portions of said exhaust nozzles beneath said supply passages to said exhaust passages.

8. In apparatus for drying a moving sheet or web, means defining a predetermined path over which said sheet or web is passed, a housing, a plurality of spaced transverse tubes extending parallel to each other across the bottom of said housing, a plurality of spaced transverse rib units alternated between said tubes and parallel thereto, the bottom of said housing being provided with a transverse opening between each adjacent tube and rib unit thereby forming alternate transverse drying fluid discharge and supply nozzles on the bottom of said housing, and means defining a plurality of individual fluid conducting passages for said nozzles within said housing.

9. In the drying apparatus defined in claim 8, each of said tubes having a substantially flat bottom face extending closely adjacent and substantially parallel to that portion of said path associated therewith.

10. Apparatus for drying a moving sheet or web comprising a pair of spaced rollers defining a path over which said sheet or web is tensed, a flat backing plate between said rollers having its upper surface substantially parallel to said path but spaced slightly therebelow, a drier station on the opposite side of said sheet or web from said path comprising a tube extending transversely of said sheet or web normal to its direction of movement, said tube having a flat bottom face extending substantially parallel to said path and disposed closely along and above said sheet or web, spaced transverse members cooperating with said tube to define spaced parallel transverse drying fluid discharge and exhaust nozzles opposite said rollers, means for supplying drying fluid to said discharge nozzle and an exhaust means connected to said exhaust nozzle, said discharge nozzle introducing an inclined stream of drying fluid which is directed onto said sheet or web countercurrent to the direction of travel of said sheet or web and is confined closely along said sheet or web surface by said flat tube face until withdrawn by said exhaust nozzle.

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