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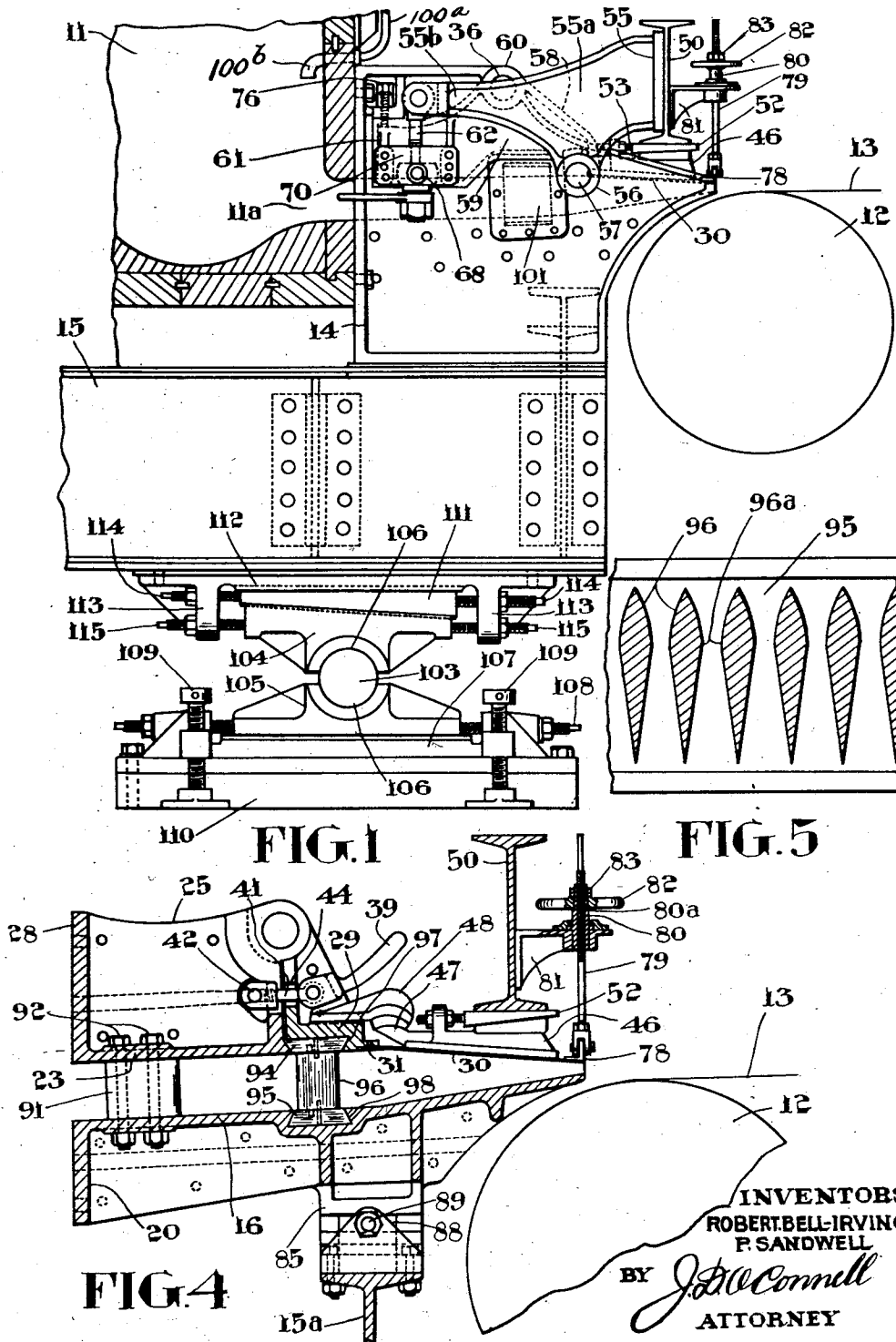
R. BELL-IRVING ET AL

1,909,150

FOURDRINIER HEAD BOX AND NOZZLE ASSEMBLY

Filed Oct. 21, 1931

4 Sheets-Sheet 1



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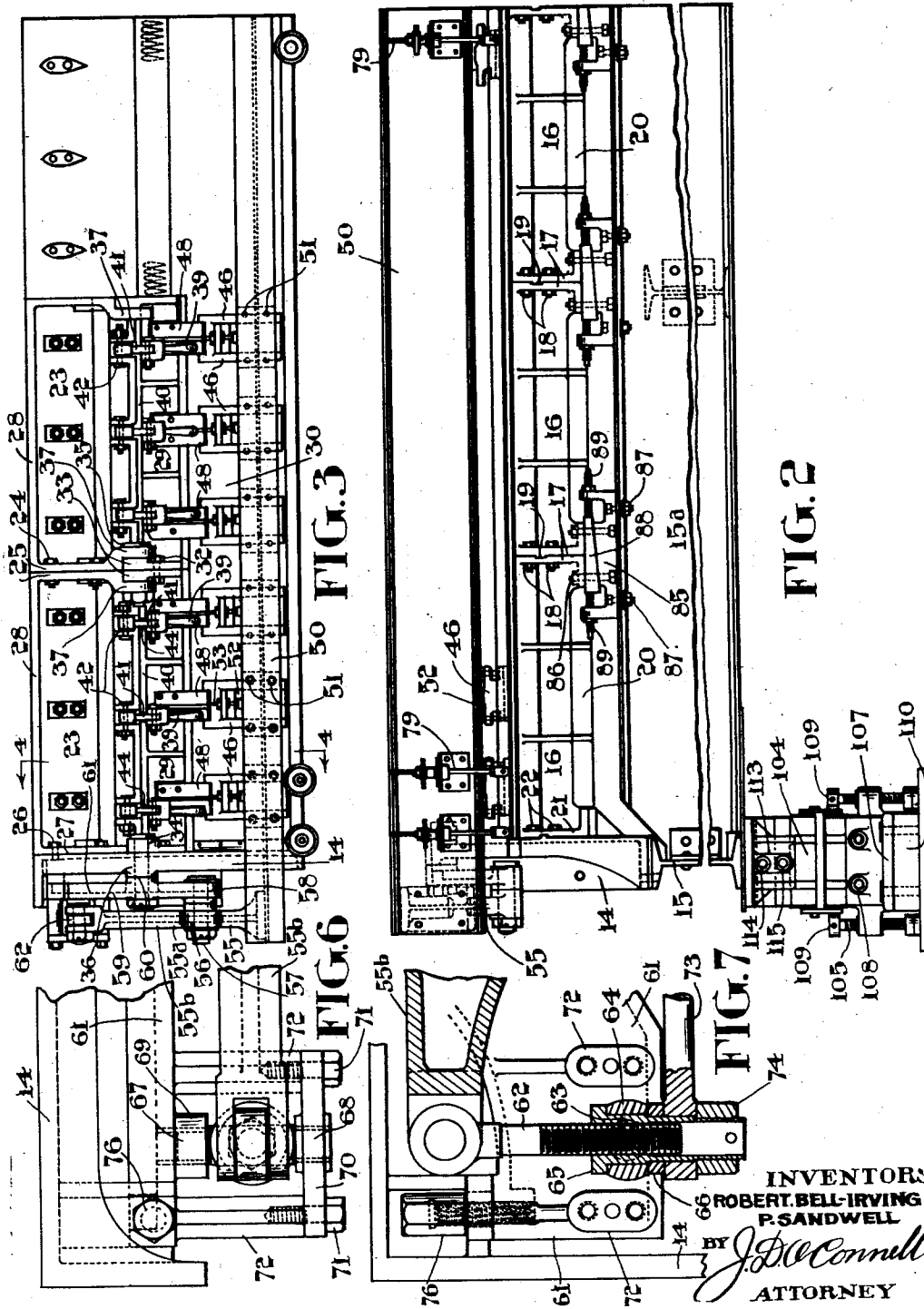
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4 Sheets-Sheet 3

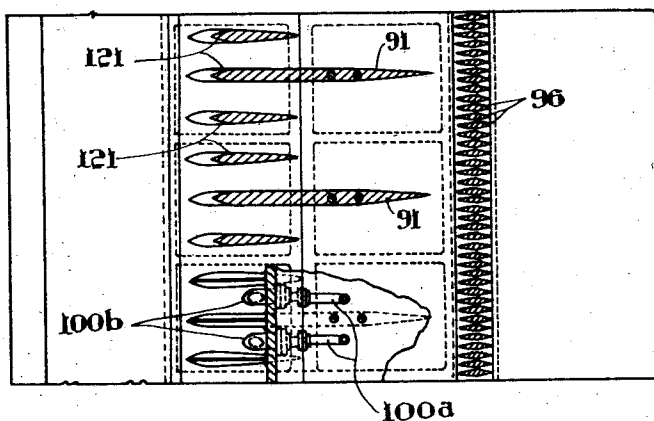


FIG. 9

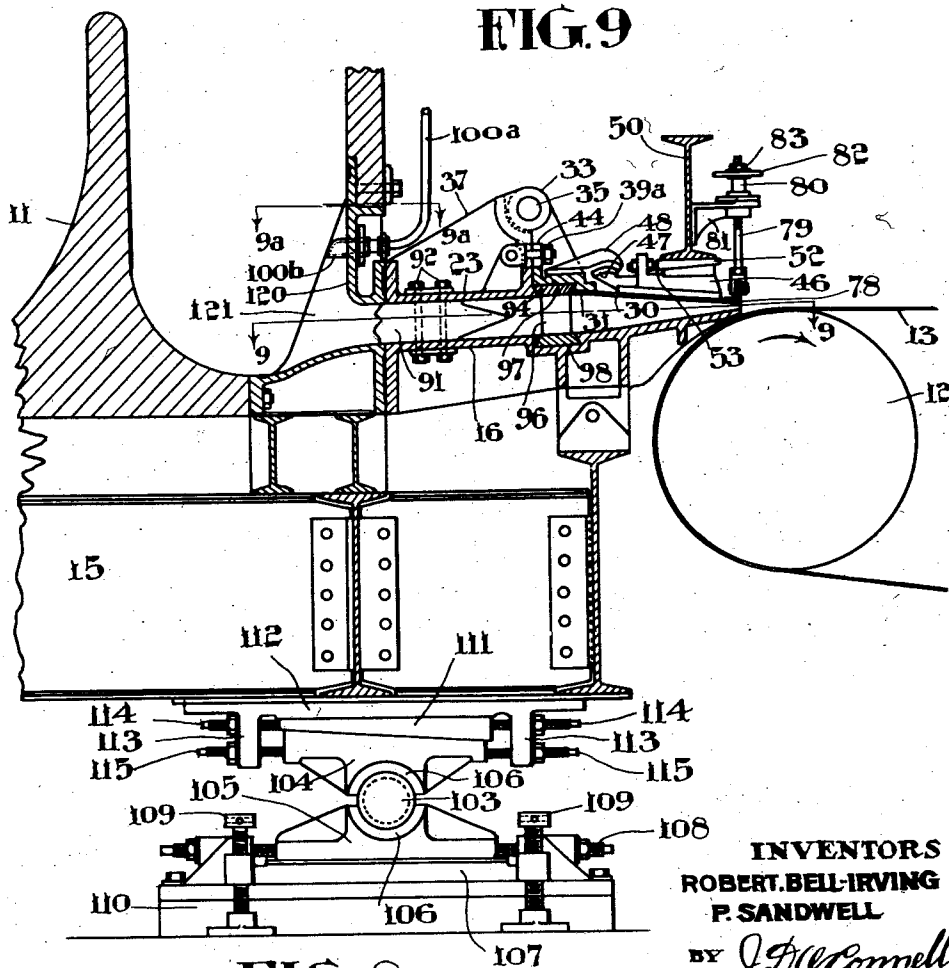


FIG. 8

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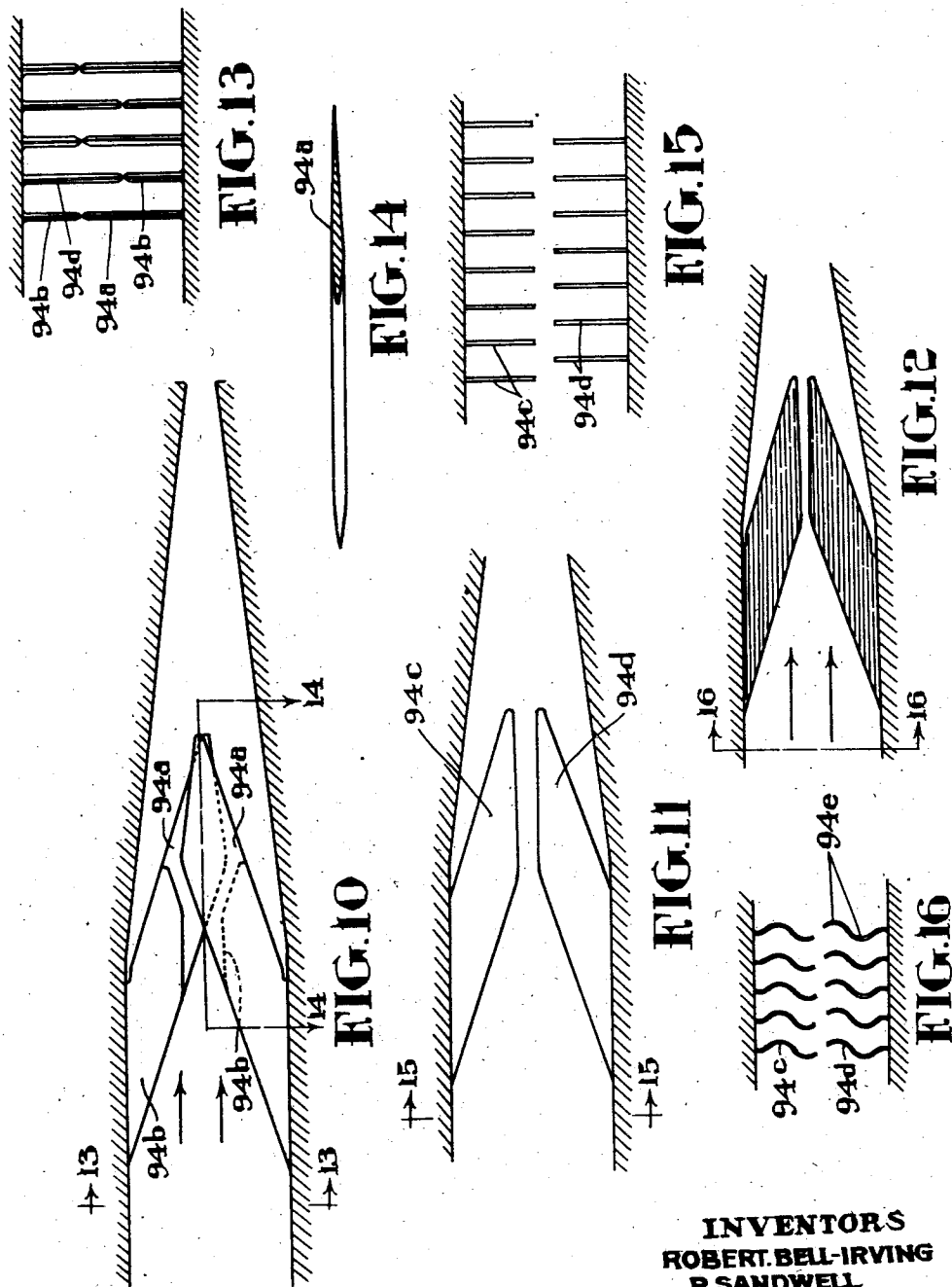
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FOURDRINIER HEAD BOX AND NOZZLE ASSEMBLY

Application filed October 21, 1931. Serial No. 570,070.

This invention relates to Fourdrinier paper machines and the object is to provide improved means for delivering the stock from the head box to the sheet forming wire.

According to this invention, the stock is conducted to the wire through a nozzle having its flow passage upwardly inclined with reference to the head box and the breast end of the wire. A flexible plate equipped with suitable adjusting means forms the upper forward wall portion of the nozzle while the bottom wall of the nozzle takes the place of the usual apron board. The flexible plate and the opposing bottom wall portion converge towards the nozzle outlet to provide a tapering throat at the beginning of which is arranged a flow rectifier of novel construction. An additional rectifier may also be arranged at the entrance end of the nozzle together with a suitable arrangement of dilution pipes through which streams of water are delivered to the stock in order to provide a sensitive means for regulating the thickness and weight at any point across the width of the sheet being formed. The head box and nozzle assembly is preferably mounted on a vertically and horizontally adjustable supporting grid which is also capable of being tilted to vary the height and upward inclination of the nozzle passage with respect to the breast end of the wire.

Proceeding now to a more detailed discussion of the invention, reference will be had to the accompanying drawings, wherein,

Figure 1 is a fragmentary view partly in side elevation and partly in vertical section of a head box and nozzle assembly constructed in accordance with this invention.

Figure 2 is a fragmentary front elevation of the assembly shown in Figure 1.

Figure 3 is a fragmentary plan view of the nozzle assembly detached from the head box. In this view a portion of the top wall structure is omitted to reveal the arrangement of certain elements located beneath said wall structure.

Figure 4 is an enlarged transverse sectional view taken substantially along the line 4—4 of Figure 3.

Figure 5 is a horizontal longitudinal sectional view of the rectifier.

Figures 6 and 7 are detail views of a portion of the slice plate adjusting mechanism.

Figure 8 is a view similar to Figure 4 but showing a modified assembly.

Figure 9 is principally a sectional view taken along the line 9—9 of Figure 8. In this view a portion of the structure is shown in plan in the plane of the line 9a—9a of Figure 8.

Figures 10, 11, 12 are diagrammatic views, in side elevation, of different types of rectifiers which may be employed at the throat portion of the nozzle.

Figure 13 is a sectional view taken along the line 13—13 of Figure 10 and looking in the direction of the arrows.

Figure 14 is a sectional view through one of the rectifier blades shown in Figure 10, this view being taken substantially along the line 14—14 of Figure 10.

Figure 15 is a sectional view taken along the line 15—15 of Figure 11.

Figure 16 is a sectional view taken along the line 16—16 of Figure 12.

In these drawings, the head box appears at 11; the breast roll at 12; and the paper forming wire at 13.

In accordance with the present invention, the stock is delivered from the head box to the wire through an upwardly inclined nozzle having its vertical side walls formed by a pair of end castings 14 secured to a structural supporting grid 15 on which the head box is mounted. The bottom wall of the nozzle is composed of a plurality of wall sections 16 provided with mating flanges 17 fastened together by bolts 18 (see Figures 2 and 4), it being noted that the flanges 17 are keyed together at 19 to maintain the alignment of the sections 16 and thereby ensure a smooth surface along the bottom of the nozzle flow passage. The inner edges of the sections 16 are provided with depending flanges 20 which fit against the front wall of the head box 11 and are secured thereto so that the upper surfaces of the wall sections 16 form a smooth continuation of the lower edge of the head box outlet open-

ing 11a. The end wall sections 16 are provided with depending flanges 21 fastened to the end castings 14 by bolts 22 or other suitable fastening means. The rear top wall portion of the nozzle is composed of a plurality of stationary wall sections 23 which are fastened to one another by bolts 24 passing through the mating side flanges 25 appearing in Figures 3 and 4. The end wall sections 23 are also fastened to the end castings 14 by bolts 26 passing through the flanges 27. The rear edges of the wall sections 23 are formed with further flanges 28 which are suitably secured to the front wall of the head box 11 so that the lower surfaces of the wall sections 23 form a smooth continuation of the upper edge of the head box outlet 11a.

The remaining portion of the top wall of the nozzle is formed by a plurality of wall sections 29 and a flexible slice plate 30; the rear edge of the slice plate being secured to the lower forward edge portions of the wall sections 29, as indicated at 31 in Figure 4. The wall sections 29, are bolted together as indicated at 32 (see Figure 3) and are provided with bearings 33 and 34 mounted on the pivots 35 and 36; the pivots 35 being carried by extensions 37 of the rear upper wall sections 23 and the pivots 36 being carried by the end castings 14. Upward swinging movement of the wall sections 29 with reference to the stationary wall sections 23 is normally prevented by cam levers 39 having their cam surfaces engaging the upwardly extending rear wall portions 40 of the sections 29. Each cam lever 39 is pivoted to the forward end of a link 41 having its rear end pivoted at 42 to one of the wall sections 23. The wall portions 40 of the wall sections 29 are provided with slots 44 which accommodate the links 41 when the cam levers 39 are in the operative position shown in Figures 3 and 4. These slots are open at their upper ends to permit the cam levers to be swung rearwardly out of engagement with the wall portions 40 when the sections 29 are to be swung upwardly about the pivots 35 and 36.

The slice plate 30, due to its flexibility, is movable about a hinge point located immediately in front of the forward edges of the wall sections 29 to which the slice plate is secured, as previously described. The slice plate is preferably stiffened by rivetting or otherwise securing comparatively light stiffening ribs 46 to the upper surface of the plate. The ribs 46 are provided with curved extensions 47 bearing against complementary curved extensions 48 suitably secured to the wall sections 29. The curved engaging surfaces of the extensions 47 and 48 are so arranged as to permit the supporting ribs to swing about the hinge point of the slice plate. All of the stiffening ribs 46 are carried by an I-beam 50 to which the ribs

are secured in any suitable manner, as, for example, by the bolts 51 appearing in Figure 3. A wedge 52 is interposed between each rib 46 and the overlying portion of the beam 50 and is adjustable through the medium of the screw 53 to take up the deflection of the beam and thus ensure a parallel opening between the forward edge of the slice plate 30 and the opposing corresponding edge of the bottom nozzle wall 16.

The beam 50 is carried at each end by the forwardly extending arm 55 of a lever 55a. Lever 55a is provided with an intermediate bearing 56 mounted on a pivot 57 carried by the forwardly extending arm 58 of a rocker 59. The rocker 59 is provided with an intermediate bearing 60 mounted on the previously described pivots 36 carried by the adjacent end casting 14. The rearwardly extending arm 55b of the lever 55a is adjustably secured to the rearwardly extending arm 61 of the rocker 59 through the medium of an eye bolt 62 which is shown more in detail in Figures 6 and 7. On referring to these figures it will be noted that the shank of the bolt 62 is threaded into a sleeve nut 63 which passes through the swivel 64 and is secured thereto by the flange 65 and the nut 66. The swivel 64 is mounted on trunnions 67 and 68, the trunnion 67 being supported in a bearing 69 on the arm 61 and the trunnion 68 being supported in a suitable bearing opening formed in the plate 70. The plate 70 is fastened by bolts 71 to a pair of lugs 72 projecting outwardly from the rocker arm 61. The sleeve nut 63 is operable by any suitable form of ratchet lever such as that generally indicated at 73. The ratchet lever is shown as secured to the lower portion of the sleeve nut by means of the retaining nuts 66 and 74. By turning the handle 73 the eye-bolt 62 is raised or lowered to swing the lever 55a about its supporting pivot 57 to thereby raise or lower the beam 50 which carries the slice plate 30. In order to hold the rocker 59 in the desired position any form of adjustable screw threaded connection such as that generally indicated at 76 may be provided between the rocker arm 61 and the end casting 14.

The free edge of the slice plate 30 is reinforced by an angle plate 78 to which is attached the lower ends of a plurality of threaded adjusting screws 79. These adjusting screws (see Figure 4) are threaded through rotary sleeve nuts 80 carried by the brackets 81 attached to the beam 50. A hand wheel 82 is clamped to the upper ends of each sleeve between the shoulder 80a and the nut 83.

The lower wall sections 16 of the nozzle are supported at intervals from the beam 15a of the supporting grid 15 through the medium of the wedge blocks 85. These

wedge blocks 85 are preferably bolted to the wall sections 16 as indicated at 86 and to the beam 15a as indicated at 87. A wedge 88 is interposed between each block 85 and the overlying wall sections 16 and is adjustable through the medium of the screws 89 to align the forward edge of the wall sections 16 with the breast.

A series of spaced stream line struts or spacers 91 are interposed between the rear top wall sections 23 of the nozzle and the underlying portions of the bottom wall sections 16 and are held in place by the bolts 92. These struts are provided mainly for the purpose of supporting the wall sections 23 but they are also designed to prevent splaying of the wall sections 16 and 23 by internal pressure.

It will be noted that the slice plate 30 and the opposing portion of the bottom wall 16 converge towards the outlet end of the nozzle to provide a tapering throat and a flow rectifier of novel construction is arranged in the nozzle at a point in proximity to the beginning of this throat portion. This flow rectifier may be constructed in various ways but that shown in Figures 1 to 8 inclusive, comprises an upper carrier bar 94 and a lower carrier bar 95, connected together by a plurality of interposed vertically extending vanes 96 spaced apart to provide intervening flow passages. The upper carrier bar 94 is slidably mounted in a guide way 97 formed in the wall sections 29 while the lower carrier bar 95 is similarly mounted in a guide way 98 formed in the wall sections 16. As shown to advantage in Figure 5 the vanes 96 are stream lined in cross section so that the flow passage formed between adjacent vanes abruptly decreases in transverse width from the inlet end of the passage to an intermediate point 96a and then gradually increases in width to the outlet end of the passage.

In place of the rectifier described above we may employ any one of the several modified arrangements shown in Figures 10 to 16 inclusive.

In the construction shown in Figures 10, 13 and 14, the rectifier consists of upper and lower sets of vertically disposed blades arranged so that no one blade extends entirely across the flow passage of the nozzle. Each set of blades comprises a plurality of long blades 94a alternating with short blades 94b said blades being inclined so that the leading and trailing edges are sloped in such manner that the general alignment of these edges tends towards the direction of flow and a substantial clearance is provided between the edges of the upper blades and the opposing edges of the lower blades, as well as between the leading and trailing edges of the blades and the opposing wall surfaces of the nozzle. One advantage of this par-

ticular type of rectifier is that fragments of pulp lodging on the edge of a blade are immediately swept off by the flow of the surrounding stock so that formation of lumps is substantially prevented and the rectifier is rendered entirely self-cleaning. Another advantage of this particular type of rectifier is that it may be mounted in the flow passage of the nozzle at a point where the contraction of the passage is such that the velocity of flow is high, thus producing improved rectification. It may be explained here that if rectification at high velocity is attempted with blades which extend entirely across the flow passage, as shown in Figure 4, it is quite possible that the formation of lumps would be promoted to such an extent as to seriously affect the quality of the sheet and the operation of the machine. The rectifying blades 94a and 94b of both sets are preferably stream lined in cross section as shown to advantage in Figure 14.

In the modified construction shown in Figures 11 and 15 the rectifier consists of an upper series of blades 94c of uniform length and a lower series of similar blades 94d. In this case the leading and trailing edges of the blades are sloped as explained in connection with Figures 10, 13 and 14 but the blades 94c are staggered horizontally with respect to the blades 94d. The staggering of the blades is of advantage in that it prevents vertical stratification across the width of the flow which, if permitted to occur, would be reflected by the formation of corresponding valleys and crests on the sheet flowing onto the wire.

The construction shown in Figures 12 and 16 is similar to that shown in Figures 11 and 15, except that the blades 94c and 94d are corrugated, as indicated at 94e, in order to provide for both vertical and horizontal rectification.

A plurality of distributing pipes appearing at 100a in Figure 1 are arranged to extend into the head box 11 and are provided with discharge nozzles 100b positioned above the outlet to the entrance end of the nozzle. Water drawn from any suitable source is pumped or otherwise supplied to these nozzles under the control of suitable regulating valves (not shown).

In the modified construction shown in Figures 8 and 9 the outlet from the head box is formed by a metal casting 120 provided with suitable openings in its upper portion for the insertion of the nozzles 100b of the pipes 100a. This casting is also provided with a series of vertically disposed rectifying blades 121 between which the nozzles 100b are arranged. As shown to advantage in Figure 9, certain of the rectifying blades 121 are positioned to form symmetrical continuations of the struts 91 so that these struts are also utilized for rec-

tifying purposes. The remainder of the nozzle assembly shown in Figures 8 and 9 is substantially the same as previously described except that the cam levers 39 are

5 replaced by simple swinging bolts 39a. Having described the construction and relative arrangement of the various elements comprising the complete nozzle assembly the functions and advantages of

10 these elements will now be briefly reviewed as follows.

The general arrangement of the nozzle assembly so that the flow passage through the nozzle is upwardly inclined with respect

15 to the head box is of advantage in that it enables the bottom wall of the nozzle to take the place of the usual apron board. It also provides for a smooth entry of the stock onto the wire, since the upward in-

20 clination of the flow passage and the force of gravity causes the discharge from the nozzle to take the form of a parabola so that, by properly locating the position of the nozzle in relation to the position of the breast

25 roll, it is possible to have the discharge moving parallel with the surface of the wire at a point adjacent to the top of the breast roll thereby avoiding disturbance to the flow. The rectifier contained within the nozzle

30 flow passage is positioned at or near the beginning of the throat portion so that the tendency of streaks or ripples formed by the rectifier to carry through to the nozzle outlet is substantially reduced by reason of the

35 fact that the throat provides a chamber wherein the separate streams passing through the flow passages of the rectifier are merged together before reaching the nozzle outlet. In order to achieve efficient rec-

40 tification, the flow passages through the rectifier should be designed to produce a definite velocity increase sufficient to cause a notable head loss and this requirement is

45 effectively met by stream lining the rectifying blades to provide the peculiar shaped flow passages previously described. This stream lining is not, however, absolutely essential since desirable results may be obtained with the use of rectifying blades

50 having parallel surfaces in the direction of flow. The injection of fresh or white water through the dilution pipes and nozzles provided for this purpose affords a very sensitive means for increasing or decreasing the

55 weight or thickness of the sheet at any point across its width. The dilution pipes should work in close conjunction with the rectifying means but this can be accomplished by arranging the dilution pipes in various rela-

60 tions with respect to the rectifying blades so that the amount of discharge into the different passages of the rectifying means is definitely controlled.

The primary adjustment of the nozzle

65 opening is accomplished by raising and low-

ering the slice plate 30 through the instrumentality of the beam 50, levers 55a and adjusting screws 62, the finer adjustments being accomplished through the medium of the adjusting screws 79. Access to the rec-

70 tifier for cleaning or removing same is facilitated by vertical displacement of the wall sections 29 and the slice plate 30 to free the upper carrier bar 94 of the rectifier, such

75 displacement being provided for by the pivotal mounting of the wall sections 29, and the rocker 59 which carries the beam supporting levers 55a. Removal or insertion of the rectifier may also be accomplished by

80 sliding the same through suitable openings in the end frames 14 which are normally closed by the cover plates 101.

It is preferred that the head box and nozzle assembly be capable of vertical and horizontal adjustment with reference to the

85 breast end of the wire and that the upward inclination of the nozzle be variable within certain limits. To this end the front and rear corner portions of the grid 15 are

90 mounted on adjustable supports of duplicate construction, one of which appears in Figures 1 and 2. Each support includes a

95 roller 103 interposed between bearing members 104 and 105 equipped with curved roller engaging surfaces 106. The lower bearing member 105 is slidably mounted on

100 a base plate 107 and is horizontal adjustable through the medium of the adjusting screws 108. The base plate 107 is equipped with

105 jack screws 109 and normally rests on a block 110 positioned therebeneath. A wedge 111 is interposed between the upper bearing member 104 and a plate 112 attached to the

110 grid 15. The plate 112 is provided with depending lugs 113 carrying the adjusting screws 114 and 115. The screws 114 bear

115 against opposite ends of the wedge 111 while the screws 115 bear against opposite ends of the bearing member 104. Vertical adjustment of the head box and nozzle assembly

120 is accomplished by adjustment of the bearing member 104 and the wedge 111 through the medium of the screws 114 and 115. Horizontal adjustment of the assembly is accomplished by adjustment of the

125 screws 108 to shift the lower bearing member 105, along the supporting surface of the base plate 107. The upward inclination of the nozzle passage may be varied by independent vertical adjustment of the front

130 and rear bearing members and additional vertical adjustment may be obtained by removing the blocks 110 from beneath the base plates, this operation being facilitated by provision of jack screws 109.

Having thus described our invention, what we claim is:—

1. In a Fourdrinier paper machine a nozzle presenting an upwardly inclined flow

130 passage for conducting the paper stock from

the head box to the sheet forming wire and a rectifier arranged in said passage.

2. In a Fourdrinier paper machine, a nozzle presenting an upwardly inclined flow passage for conducting the paper stock from the head box to the sheet forming wire, a flow rectifier in said passage, and a plurality of water inlets arranged in proximity to the entrance end of the nozzle.

3. In a Fourdrinier paper machine a nozzle presenting an upwardly inclined flow passage for conducting the paper stock from the head box to the sheet forming wire, a flow rectifier positioned in said passage inwardly of the outlet end of the passage, and a plurality of water inlets arranged to deliver streams of water to the stock at points rearwardly of the flow passages of the rectifier.

4. In a Fourdrinier paper machine a nozzle presenting a flow passage for conducting stock from the head box to the sheet forming wire, flow rectifying means positioned in the nozzle adjacent the delivery end of the passage and additional flow rectifying means positioned adjacent the entrance end of the passage.

5. The construction claimed in claim 4 in which the nozzle flow passage is inclined upwardly from the head box to the sheet forming wire.

6. In a Fourdrinier paper machine a nozzle presenting a flow passage for conducting the paper stock from the head box to the sheet forming wire, a flow rectifier arranged in said nozzle adjacent the delivery end of the passage, additional rectifying means arranged adjacent the entrance end of the passage, and a series of water inlets arranged to permit dilution of the stock flowing through the nozzle in order to regulate the thickness and weight of the stock at points across the width of the sheet being formed.

7. In a Fourdrinier paper machine, a nozzle presenting a flow passage for conducting the paper stock from the head box to the sheet forming wire, flow rectifying blades arranged in said nozzle adjacent the delivery end of the nozzle, additional flow rectifying blades arranged adjacent the entrance end of the passage, and water inlets arranged to deliver streams of water between the last mentioned blades.

8. In a Fourdrinier paper machine, a nozzle presenting a flow passage for conducting paper stock from the head box to the sheet forming wire, and a plurality of internal reinforcing struts spaced across the width of the nozzle and fastened to the upper and lower wall portions of the flow passage.

9. In a Fourdrinier paper machine, a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire, an adjustable apron plate forming the forward upper wall portion of

the nozzle, a flow rectifier positioned in said passage rearwardly of the apron plate, and a series of water inlets arranged to deliver streams of water to the stock at points rearwardly of the flow passages of the rectifier.

10. In a Fourdrinier paper machine, the combination of a head box, a nozzle attached thereto and arranged to provide an upwardly inclined flow passage for conducting stock from the head box to the forming wire, a vertically and horizontally adjustable base supporting the head box and nozzle assembly and means for raising, lowering and tilting the base to vary the height and upward inclination of the nozzle flow passage relative to the wire.

11. In a Fourdrinier paper machine, a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire, an adjustable apron plate forming the forward upper wall portion of the nozzle, a beam attached to the upper wall portion of the nozzle, a beam attached to the upper surface of said plate, and means for adjustably supporting said beams.

12. In a Fourdrinier paper machine a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire, an adjustable apron plate forming the forward upper wall portion of the nozzle, an adjustably mounted beam attached to the upper surface of the apron plate, and adjustable means interposed between the apron plate and beam to compensate for deflection of the beam.

13. In a Fourdrinier paper machine, a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire, a movable apron plate forming the forward upper wall portion of the nozzle, a beam attached to the apron plate and adjustable levers supporting said beam.

14. In a Fourdrinier paper machine, a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire, and adjustable means engageable with the lower wall of the nozzle to align the lower edge of the outlet end of the flow passage with the breast roll end of the wire.

15. In a Fourdrinier paper machine, a nozzle arranged to provide a flow passage for conducting stock from the head box to the forming wire and a flow rectifier arranged in said passage, said nozzle being of sectional construction permitting convenient placement and removal of the rectifier.

16. A flow rectifier presenting a row of parallel flow passages separated by vertically disposed blades, said blades being streamlined in cross section so that each passage gradually decreases in width from its inlet end to an intermediate point from whence

the width of the passage gradually increases toward the outlet end.

17. In a Fourdrinier paper machine, a nozzle presenting a flow passage for conducting the paper stock from the head box to the sheet forming wire and a flow rectifier arranged in said passage, said rectifier comprising opposed sets of rectifying blades, the blades of one set extending upwardly from the lower wall of the passage and terminating short of the upper wall and the blades of the remaining set extending downwardly from the upper wall of the passage and terminating in spaced relation to the lower wall.

18. The construction claimed in claim 17 in which each set of blades includes alternately arranged long and short blades.

19. The construction claimed in claim 17 in which the blades of one set are disposed out of vertical alignment with the blades of the opposing set.

20. The construction claimed in claim 17 in which the blades are of undulating or corrugated form in cross section.

21. The construction claimed in claim 17 in which the leading and trailing edges of the blades are inclined in the direction of flow through said passage.

22. In a Fourdrinier paper machine, the combination of a head box, a nozzle attached thereto and arranged to provide an upwardly inclined flow passage for conducting stock from the head box to the wire, an adjustable base supporting the head box and nozzle assembly and means for adjusting the base to vary the upward inclination of the nozzle flow passage relative to the wire.

In witness whereof we have hereunto set our hands.

ROBERT BELL-IRVING.
PERCY SANDWELL.