July 4, 1972 O. R. EVALAHTI 3,674,633
HEADBOX FOR A PAPER MACHINE PROVIDING FOR SIMULTANEOUS ADJUSTMENT OF THE FRONT WALL AND MIXING ROLL THEREIN
Filed April 13, 1970 6 Sheets-Sheet 1

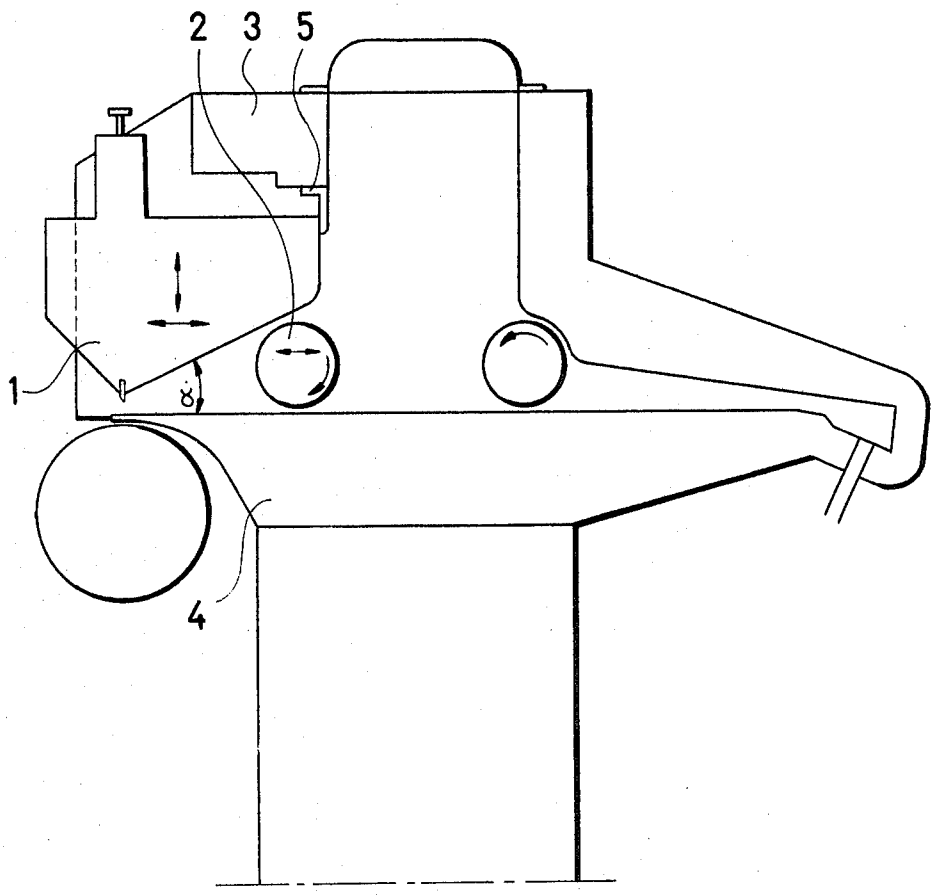

Fig. 1

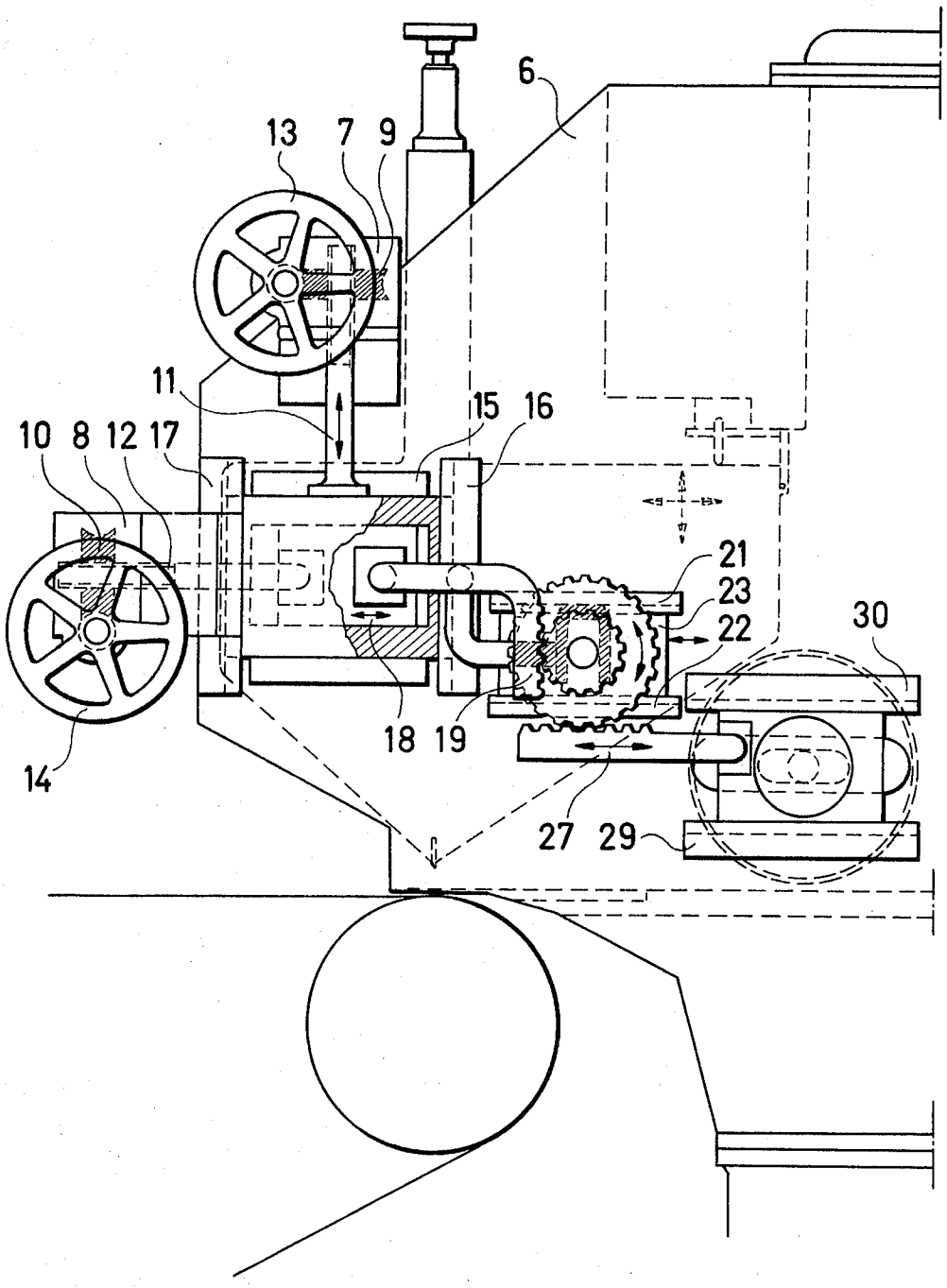

Fig. 2

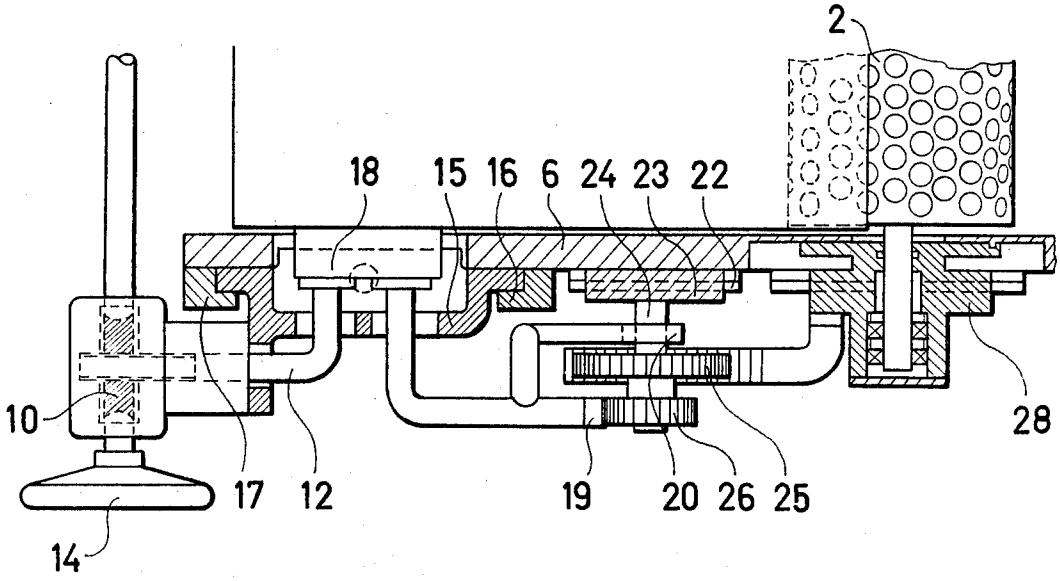

Fig. 3

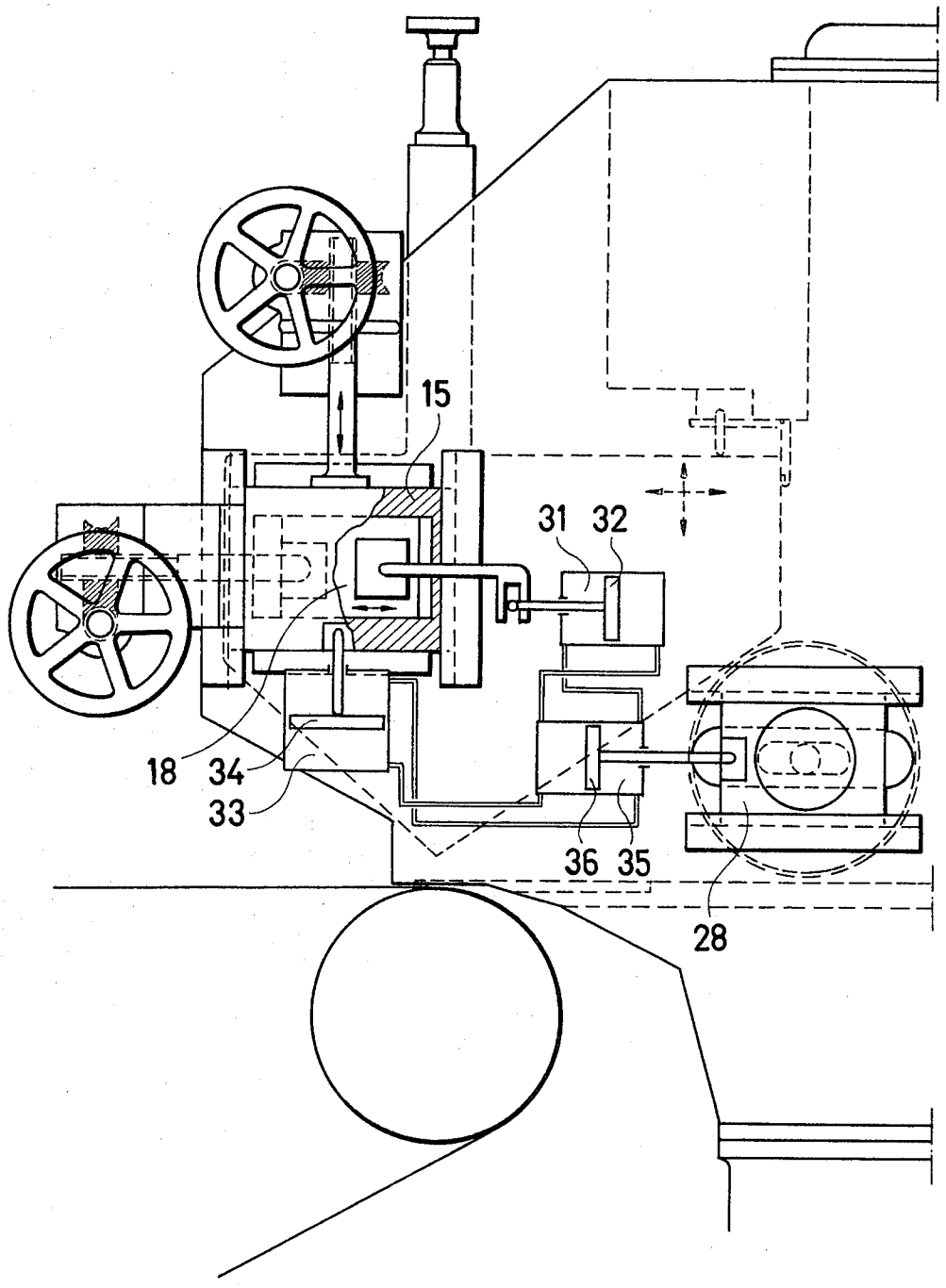

Fig. 4

July 4, 1972 O. R. EVALAHTI 3,674,633
HEADBOX FOR A PAPER MACHINE PROVIDING FOR SIMULTANEOUS ADJUSTMENT OF THE FRONT WALL AND MIXING ROLL THEREIN
Filed April 13, 1970 6 Sheets-Sheet 5

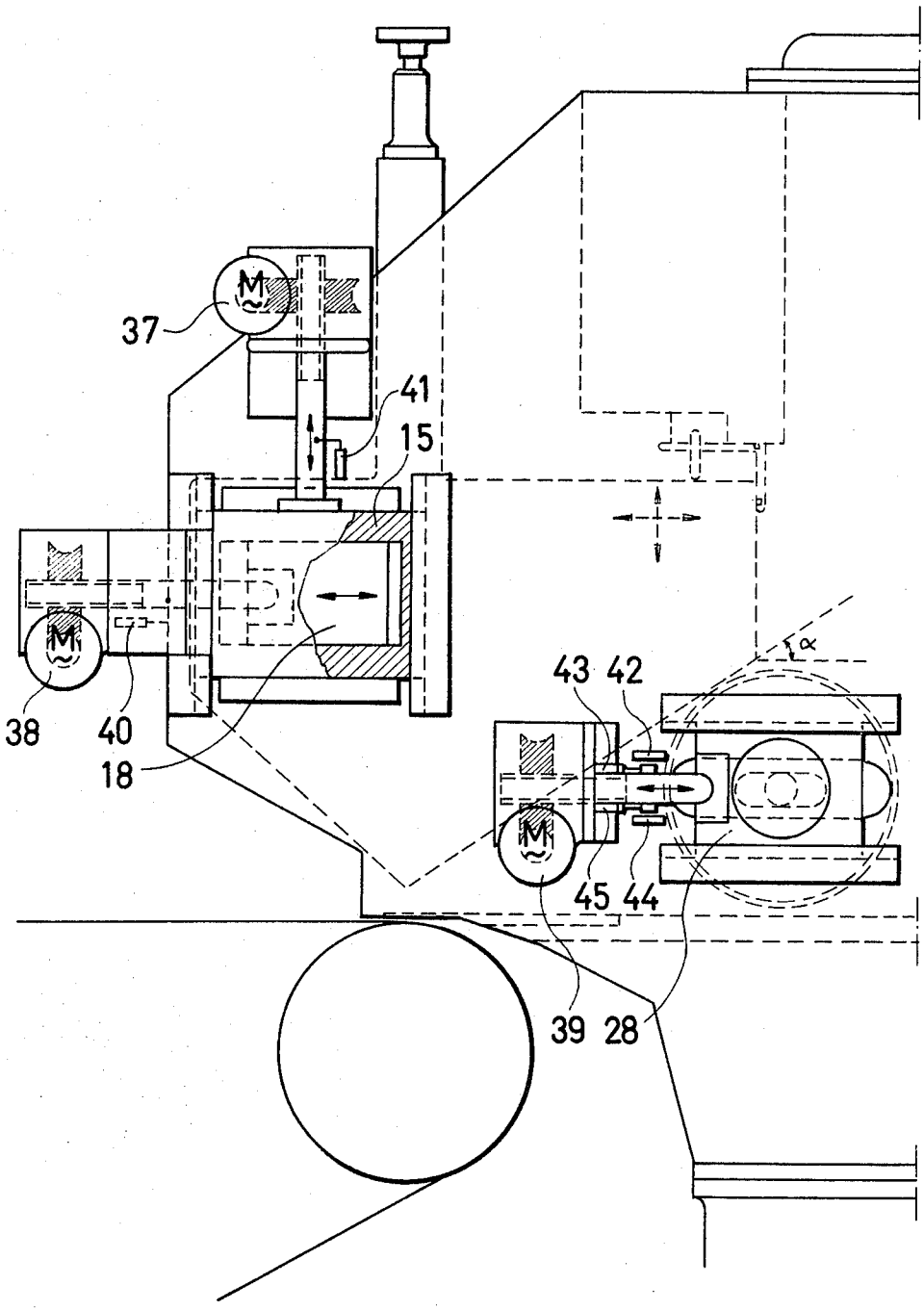

Fig. 5

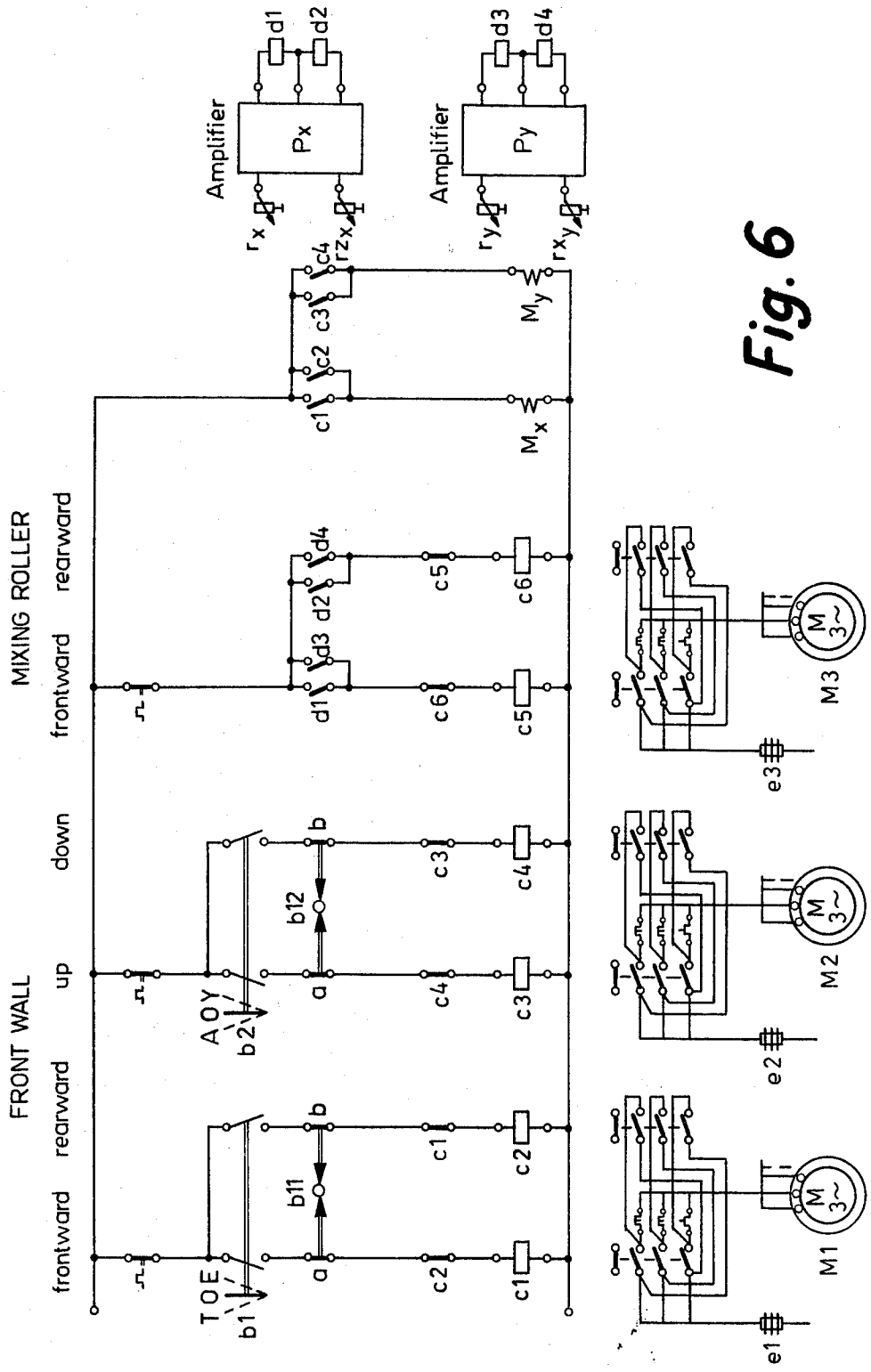
Amplifier
Px
Amplifier
Py
d1
d2
d3
d4
rx
rzx
ry
rxy
c4
c3
c2
c1
My
Mx
MIXING ROLLER
frontward
rearward
d4
d2
d3
d1
c5
c6
FRONT WALL
down
up
rearward
frontward
b
b12
a
AOY
b2
TOE
b1
b11
M
3~
M3
M2
M1
e3
e2
e1

Fig. 6

United States Patent Office

3,674,633

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3,674,633

HEADBOX FOR A PAPER MACHINE PROVIDING FOR SIMULTANEOUS ADJUSTMENT OF THE FRONT WALL AND MIXING ROLL THEREIN

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Claims priority, application Finland, Apr. 15, 1969, 1,094/69
Int. Cl. D21f 1/02
U.S. Cl. 162—342 7 Claims

ABSTRACT OF THE DISCLOSURE

In the headbox of a paper machine there is a vertically and horizontally adjustable front wall, which together with the bottom plate of the headbox constitutes a slice portion, the angle of which, α, is less than 90 degrees, and in which the mixing roller has been placed close to the slice portion. In the event of the front wall being displaced for the purpose of changing the slice gap the mixing roller is so displaced that the distances of the mixing roller from the front wall and from the bottom plate remain unchanged.

The mixing roller has been arranged in the event of displacement of the adjustable front wall in the direction parallel to the bottom plate to be displaced parallel to the bottom plate through the same distance and the mixing roller has been arranged in the event of the adjustable front wall being displaced through the distance (a) in the direction perpendicular to the bottom plate to be displaced parallel to the bottom plate through the distance $a/\tan \alpha$.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to the field of paper machine headboxes.

DESCRIPTION OF THE PRIOR ART

It has been found to be expedient in paper machines to design the slice portion of the headbox to be such that the upper lip is adjustable both in horizontal and in vertical direction. This is accomplished by displacing the upper lip and/or the front wall, to which the upper lip has been attached. The displacement of the front wall of the headbox has the consequence that its distance from the mixing roller mounted adjacent to it changes. It is important from the viewpoint of efficient action of the mixing roller, on the other hand, that the gap between the mantle of the mixing roller and the front wall remains small and unchanged. In order to satisfy this requirement various means have been employed. Of the solutions belonging to prior art, for instance, one may be mentioned which has been presented in the U.S. Pat. No. 2,750,854 and in which the movable part of the front wall can be turned so that its distance from the mixing roller is virtually constant while the lip angle is altered. In a design of this kind difficulties are encountered e.g. in achieving efficient sealing between the stationary and moving parts. This sealing point lies below the liquid level in a region where one should strive to use as smooth surfaces as possible so that no fibre accumulations might form at any point, and in the instance in question an undesirable step is formed there. Moreover, the change of the slope of the front wall, that is of the lip angle, is a drawback which exerts a detrimental effect because the pulp suspension will flow onto the wire under different angles, depending on the width of the slice gap.

Furthermore, such solutions are previously known according to which the mixing roller can be moved, governed by a slide or cam device, as has been disclosed in the

British Pat. No. 927,934. In both instances the desired result, that is unchanged distance of the perforated roller both from the front wall and from the bottom plate, is only approximately achieved. Another drawback characteristic of these designs is that the roller does not follow along with the movement of the front wall but has to be separately adjusted.

The object of the present invention is to provide an adjustable front wall and mixing roller design for headboxes in which the roller follows along with the movement of the front wall so that its distance from the front wall and from the bottom plate remains unchanged.

SUMMARY OF THE INVENTION

According to the invention there is provided means for displacing the mixing roller parallel to the bottom plate through a distance equal to the displacement of the adjustable front wall in the horizontal direction parallel to the bottom and through a distance $a/\tan \alpha$, in which (a) represents the displacement of the adjustable front wall in the vertical direction perpendicular to the bottom in order to maintain the distances of the mixing roller from the front wall and the bottom constant despite displacing the front wall for the purpose of adjusting the slice gap.

The headbox according to the invention offers the advantage of providing an arrangement in which the upper lip of the slice portion is adjustable horizontally as well as vertically, yet without causing any changes in the distance of the front wall and bottom of the headbox from the mixing roller closest to the slice portion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 displays in the manner of a sketch the design principle of a headbox according to the invention, in longitudinal section.

FIG. 2 shows the slice portion of a headbox according to the invention, with mechanical design solution, in elevational view.

FIG. 3 shows the same as FIG. 2, viewed from above.

FIG. 4 shows a hydraulic or pneumatic design solution in elevational view.

FIG. 5 shows an electrified design solution, and

FIG. 6 shows the circuit diagram of the electrical solution.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is characteristic of the design that the front wall and mixing roller have been mutually coupled by means of a mechanical, hydraulic, pneumatic or electrical transmission in such manner that when the front wall is displaced parallelly with reference to the bottom plate the position of the mixing roller with reference to the front wall does not change. When the front wall is displaced in the direction perpendicular to the bottom plate, the mixing roller is displaced in a direction parallel to the bottom plate, whereby its position with reference to the front wall changes, but the gap between the front wall and the roller remains unchanged.

FIG. 1 shows the structural principle of the headbox in question. The component **1** is the adjustable front wall, and **3** is the fixed front wall, **2** is the mixing roller, and **4** is the bottom plate of the box. The angle between the front wall and the bottom plate, α, is the lip angle, **5** is a sealing component which follows along with the movement of the adjustable front wall parallel to the bottom plate.

First embodiment

FIG. 2 shows a mechanical device according to the invention in elevational view and FIG. 3 shows the same, viewed from above, **6** is the side plate of the box, to which the operating unit **7** for the movement of the front wall in the direction perpendicular to the bottom plate has been

attached. The operating unit comprises a worm gear **9** with a threaded hole and, inside this hole, a threaded spindle **11**, which moves when the gear **9** is rotated by means of the hand wheel **13** or alternatively by motor drive. One end of the spindle **11** has been attached to the slide element **15**, which is guided in its movement by the guides **16** and **17**. On the slide element **15** has been mounted an operating unit **8**, comprising a hand wheel **14**, worm gear **10** and spindle **12**, one end of the latter being attached to the slide element **18** guided with reference to the slide element **15** and which moves parallel to the bottom plate when the worm gear **10** is rotated by the hand wheel or alternatively by motor drive. The slide element **18** has been attached to the adjustable front wall **1** and it is rigidly connected with the tooth rack **19**, which is perpendicular to the bottom plate, and to the guiding fork **20** (see FIG. 3). On the side wall guides **21**, **22** have been fixed, by which the slide **23** is guided in its movements. The slide element **23** carries a pin **24**, on which the gears **25**, **26** have been rotatably journalled (see FIG. 3), which have been mutually connected so that they revolve both together. The gear **26** meshes with the tooth rack **19** and the gear **25**, with a tooth rack **27** parallel to the bottom plate, which is free to move in the direction parallel to the bottom plate and to displace the mixing roller in this direction. The mixing roller is journalled on the slide element **28** (see FIG. 3), to which the tooth rack **27** has been attached, and it is guided by the guides **29**, **30**. Between the slide element **28** and the side plate a gasket has been inserted.

Operation

The mode of action of the equipment described above is as follows. By turning the hand wheel **13**, movement of the adjustable front wall is accomplished in a direction perpendicular to the bottom plate. Correspondingly, movement parallel to the bottom plate is achieved with the aid of hand wheel **14**. When the front wall is displaced in the direction perpendicular to the bottom plate, the tooth rack **19** follows along with its movement. The gears **26** and **25** will then revolve about the stationary shaft **24** and the tooth rack **27**, which is in mesh with the gear **25**, will be displaced and will push the mixing roller in the direction parallel to the bottom plate. The diameters of the gears have been chosen so that if the displacement of the front wall at right angles to the bottom plate is a and the lip angle is α, the displacement of the mixing roller parallel to the bottom plate will be $a/\tan \alpha$. When the front wall is displaced parallel to the bottom plate, which is accomplished by turning the hand wheel **14**, the shaft of the gears **26** and **25** will be displaced through the same distance. In this case the gears do not revolve, whereby the tooth rack **27** and the mixing roller **2** are also displaced through the same distance.

Second embodiment

An alternative, hydraulic design solution has been shown in FIG. 4. In this, a piston **34** has been attached to the slide **15**, which piston moves in the cylinder **33**. To the slide **18** has been attached the piston **32**, which moves in the cylinder **31**. To the slide **28** of the mixing roller the piston **36** has been attached, which moves in the cylinder **35**. The cylinders are filled with fluid and mutually connected by pipelines. The areas of the pistons **34**, **32** and **36** have been chosen so that the movements of pistons **34** and **32** cause such displacement of the piston **36** that the mixing roller follows along with the adjustable front wall in the manner described.

Third embodiment

Another alternative solution has been shown in FIG. 5. In this, the motor **37** has been provided for displacement of the slide **15**, the motor **38** for displacement of slide **18**, and the motor **39** for displacing the slide **28** of the mixing roller.

One possible way of controlling the mixing roller displacing motor **39** has been presented in FIG. 6. The switches $b1$ and $b2$ are operated to control the motors M1 (**38**) and M2 (**37**), whereby the front wall moves in the rearward/frontward and up/down direction, respectively.

The motor M3 (**39**) is required to move the mixing roll so that the distance between the roller and the inclined portion of the inner wall remains constant. The position of the front wall is monitored by the potentiometers rx (**40**) and ry (**41**). When, for instance, the switch $b1$ is actuated to operate motor M1 in the frontward direction, the magnet Mx (**42**) is simultaneously energized and locks the slide contact of potentiometer rzx (**43**) to be immovable. As a result of the frontward displacement of the front wall, the bridge circuit composed of rx and rzx is unbalanced, and the relay $d1$ connected to the output of the amplifier px attracts its armature. The auxiliary contact of $d1$ actuates the contactor C5, whereby the motor M3 (**39**) will displace the mixing roller by an amount sufficient to balance the bridge circuit of rx and rzx.

In order that the original requirement might be fulfilled when the motor M2 (**37**) moves the front wall in the up/down direction, a voltage is fed to potentiometer ry (**41**) which is a multiple equivalent to the factor $1/\tan \alpha$, referred to the supply voltages of rx, rzx and rzy.

It follows that to any movement of ry (**41**) corresponds a movement of rzy which is its multiple by the factor $1/\tan \alpha$.

In the first, second and third embodiments the guides **16**, **17** may also be attached to the side walls of the headbox parallel to the bottom plate. In these modifications the slide **15** is movable parallel to the bottom and the slide **18** is movable perpendicular to the bottom.

What is claimed is:

1. In a paper machine an improved headbox, comprising an inlet for the pulp, rear and side walls, a bottom plate, a vertically and horizontally adjustable front wall, which together with the bottom constitutes an outlet slice portion having an acute angle α, and a mixing roller in close proximity to the slice portion, the improvement comprising:

means actuated by movement of the front wall for automatically displacing the mixing roller parallel to the bottom plate simultaneously with the front wall through a distance equal to the displacement of the adjustable front wall in the horizontal direction parallel to the bottom plate when the adjustable front wall is displaced in the horizontal direction and through a distance $a/\tan \alpha$ when the adjustable front wall is displaced in the vertical direction, in which (a) represents the displacement of the adjustable front wall in the vertical direction perpendicular to the bottom plate in order to maintain the distances of the mixing roller from the front wall and the bottom plate constant despite displacing the front wall for the purpose of adjusting the slice gap.

2. An improved headbox as recited in claim **1**, in which the means for displacing the mixing roller comprises:

(a) a first pair of guides perpendicular to the bottom plate and attached to both side walls of the headbox;

(b) a first slide movable along the first guides perpendicular to the bottom plate;

(c) means for displacing the first slide;

(d) a second slide movable parallel to the bottom plate in the first slide and attached to the adjustable front wall;

(e) means for displacing the second slide;

(f) a second pair of guides parallel to the bottom plate and attached to both side walls of the headbox;

(g) a third slide movable parallel to the bottom plate along the second pair of guides and provided with a shaft fixed thereto;

(h) a first gear wheel carried on the shaft fixed to the third slide, which first gear wheel in its turn has been

positively connected to a second gear wheel carried on the same shaft;

(i) a guiding fork embracing the shaft of the third slide and attached to the second slide for transmitting the movement of the second slide, parallel to the bottom plate, to the third slide;

(j) a third pair of guides parallel to the bottom plate and attached to both side walls of the headbox;

(k) a fourth slide on which the mixing roller has been journalled for movement parallel to the bottom plate and along the third pair of guides;

(l) a horizontal tooth rack attached to the fourth slide parallel to the third pair of guides and arranged in drive engagement with the first gear wheel; and

(m) a vertical rack fixed to the second slide for transmitting vertical movement of the first slide to the second gear wheel and thence through the first gear wheel, the horizontal tooth rack and the fourth slide to the mixing roller in the ratio of $a/\tan \alpha$.

3. An improvement as recited in claim **2**, in which the first pair of guides are parallel to the bottom plate, the first slide is movable along the first guides parallel to the bottom plate and the second slide is movable perpendicular to the bottom plate in the first slide.

4. An improved headbox as recited in claim **1**, in which the means for displacing the mixing roller comprises:

(a) a first pair of guides perpendicular to the bottom plate and attached to both side walls of the headbox;

(b) a first slide movable along the guides perpendicular to the bottom plate;

(c) means for displacing the first slide;

(d) a second slide movable parallel to the bottom plate in the first slide and attached to the adjustable front wall;

(e) means for displacing the second slide;

(f) a second pair of guides parallel to the bottom plate and attached to both side walls of the headbox;

(g) a third slide on which the mixing roller has been journalled for movement parallel to the bottom plate and along the second pair of guides;

(h) a first pressure fluid operated piston mounted for movement in a first cylinder fixed to both side walls of the headbox, said first piston being operatively connected to said third slide;

(i) a second pressure fluid operated piston mounted for movement in a second cylinder communicating with the first cylinder, said second piston being operatively connected to said first slide;

(j) a third pressure fluid operated piston mounted for movement in a third cylinder communicating with the first cylinder, said third piston being operatively connected to said second slide;

(k) a guiding fork embracing a shaft carried by said third piston, said fork being attached to the second slide for transmitting movement of the second slide, parallel to the bottom plate to the third piston.

5. An improvement as recited in claim **4**, in which the first pair of guides are parallel to the bottom plate, the first side is movable along the first guides parallel to the bottom plate and the second slide is movable perpendicular to the bottom plate in the first slide.

6. An improved headbox as recited in claim **2**, in which the means for displacing the mixing roller comprises:

(a) a first pair of guides perpendicular to the bottom plate and attached to the both side walls of the headbox;

(b) a first slide movable along the first guides perpendicular to the bottom plate;

(c) an electrical motor for displacing the first slide;

(d) a second slide movable parallel to the bottom plate in the first slide and attached to the adjustable front wall;

(e) an electrical motor for displacing the second slide;

(f) a second pair of guides parallel to the bottom plate and attached to the both side walls of the headbox;

(g) a third slide on which the mixing roller has been journalled for movement parallel to the bottom plate and along the second pair of guides;

(h) an electrical motor for displacing the third slide; and

(i) means for connecting the electrical motors of the first, second and third slides electrically so that the movement of the front wall parallel to the bottom plate causes an equal movement of the mixing roller and vertical movement of the front wall a distance a causes a movement of the mixing roller parallel to the botom plate which has the magnitude $a/\tan \alpha$. $a/\tan \alpha$.

7. An improvement as recited in claim **6**, in which the first pair of guides are parallel to the bottom plate, the first slide is movable along the first guides parallel to the bottom plate and the second slide is movable perpendicular to the bottom plate in the first slide.

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S. LEON BASHORE, Primary Examiner

A. D'ANDREA, JR., Assistant Examiner

U.S. Cl. X.R.

162—347

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,674,633 Dated July 4, 1972

Inventor(s) Osmo Rainer Evalahti

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Claim 2, at column 5, line 15, the line should read -- (m) a vertical tooth rack fixed to the second slide for trans- --.

In claim 6, at column 6, line 35, the phrase "a/tan α." should be deleted.

Signed and sealed this 12th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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