COMMONWEALTH OF AUSTRALIA

Patents Act 1952

633869

APPLICATION FOR A STANDARD PATENT OR A STANDARD PATENT OF ADDITION

Form 1
Regulation 9

I, MITSUBISHI JUKOGYO KABUSHIKI KAISHA

of 5-1 Marunouchi 2-Chome, Chiyoda-Ku, Tokyo, JAPAN.

hereby apply for the grant of a standard patent for an invention entitled "SINGLE FACER"

which is described in the accompanying complete specification.

(To be included in the case of a Convention application)

Details of basic application(s) –

Number of basic application 16801/1989

Name of Convention country in which basic application was filed JAPAN

Date of basic application FEBRUARY 17 1989

(To be included in the case of an application made by virtue of section 51)

Number of original application

Person by whom made

(To be included in the case of an application for a patent of addition)

I request that the patent may be granted as a patent of addition to the patent applied for on Application No. ..... Patent No. .....

in the name of .....

I request that the term of the patent of addition be the same as that for the main invention or so much of the patent for the main invention as is unexpired.

P 0035 16 3-0290

My address for service is KELVIN LORD & COMPANY, Patent & Trade Mark Attorneys, 4 Douro Place, West Perth, Western Australia, 6005, AUSTRALIA.

Dated this 6th day of FEBRUARY 1990

To :

THE COMMISSIONER OF PATENTS

(Signature)
MITSUBISHI JUKOGYO KABUSHIKI KAISHA
By their Patent Attorneys
KELVIN LORD AND COMPANY

This form must be accompanied by either a provisional specification (Form 9 and true copy) or by a complete specification (Form 10 and true copy).

* These sections are to be completed only where applicable..

C. J. THOMPSON, Commonwealth Government Printer

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of Applicant(s)

In support of the application made by MITSUBISHI JUKOGYO KABUSHIKI KAISHA

Title

for a patent for an invention entitled SINGLE FACER

Name(s) and address(es) of person(s) making declaration

I/We, Arata ISHIKAWA, General Manager of Patent & License Department, MITSUBISHI JUKOGYO KABUSHIKI KAISHA 5-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan

do solemnly and sincerely declare as follows:-

1. I am/we are the applicant(s) for the patent, or am/are authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant(s) for the or each basic application

in Japan on February 17, 1989
by MITSUBISHI JUKOGYO KABUSHIKI KAISHA
in _____ on _____ 19____
by _____

3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Name(s) and address(es) of the or each actual inventor

4. The actual inventor(s) of the said invention is/are Kimio MURAYAMA, Yukuharu SEKI and Hiroaki SASASHIGE of c/o Mihara Machinery Works, MITSUBISHI JUKOGYO K.K., 5007, Itozaki-cho, Mihara, Hiroshima Pref., Japan (all of them)

See reverse side of this form for guidance in completing this part

5. The facts upon which the applicant(s) is/are entitled to make this application are as follows:-
The applicant is the assignee of the actual inventors.

DECLARED at Tokyo, Japan this 9th day of March 19 90

MITSUBISHI JUKOGYO KABUSHIKI KAISHA

Arata Ishikawa

Arata ISHIKAWA, General Manager of Patent & License Department

This form may be completed and filed after the filing of a patent application but the form must not be signed until after it has been completely filled in as indicated by the marginal notes. The place and date of signing must be filled in. Company stamps or seals should not be used.

No legalisation is necessary

KELVIN LOND & CO.

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(54) Title
SINGLE FACER

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(56) Prior Art Documents
GB 2058663
US 3707909
US 3537943

(57) Claim

1. A single facer apparatus for forming single-face corrugated sheets having a top corrugating roll, a lower corrugating roll, a gluing roll and a press roll supported on a frame and passing a sheet medium to be corrugated between said lower corrugating roll and each of said top corrugating roll, said gluing roll and said press roll, and heating means for heating each of said rolls, the improvement comprising a means for adjusting the distance between centers of support shafts of said lower corrugating roll and at least one of said top corrugating roll, said gluing roll and said press roll; a temperature sensor means for detecting the expansion of said frame caused by transfer of heat from said rolls by detecting the temperature of said frame or a sensor to detect the start of the heating operation of the heating means, and a controller for actuating said means for adjusting in

.../2

response to the detection of expansion by said temperature sensor means in order to compensate for said expansion of said frame by maintaining the distance between said centers of support shafts constant.

AUSTRALIA

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633869

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Application Number:
Lodged:

Class

Int. Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name of Applicant(s): MITSUBISHI JUKOGYO KABUSHIKI KAISHA

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WEST PERTH,
Western Australia 6005.

Complete Specification for the invention entitled:

"SINGLE FACER"

The following statement is a full description of this invention, including the best method of performing it known to me/us

SPECIFICATION

1. TITLE OF THE INVENTION

SINGLE FACER

2. FIELD OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to a single facer comprising an apparatus for correcting a distance between the centers of shafts which is adapted to adjust (correct) a contacting condition between a lower roll and other rolles such as a top roll, a press roll and a gluing roll etc., which are in contact with said lower roll.

Fig. 1 conceptionally illustrates a typical single facer which has been used in a traditional corrugating machine. The single facer is constituted as major components by a top roll having teeth 1a formed around the circumferential surface thereof and arranged for free rotary movement, a lower roll having teeth 2a formed around the circumferential surface thereof and arranged for free rotary movement with teeth 2a being engaged teeth of the top roll so that a corrugating medium 5 may be shaped into a corrugated configuration by urging the medium to enter into a gap to be formed between teeth 1a and 2a, a gluing roll 3 arranged closely adjacent to the teeth 2a of the lower roll 2 for rotary movement and is adapted to apply a predermined quantity of glues over the wavy-shaped top portion of the corrugating medium 5 which has been formed, and a press roll 4 etc., arranged to be closely adjacent to or in contact with the teeth 2a of the

lower roll 2 for rotary movement and is adapted to produce a single faced corrugated board by allowing the corrugating medium 5 with glues applied and the liner board 6 to pass between it and the lower roll 2 under pressure for lamination. Gaps to be formed between the top roll 1 and the lower roll 2, between the lower roll 2 and the gluing roll 3 and between the lower roll 2 and the press roll 4 are all made to be variable in dimensions by means of an apparatus for adjusting the roll contacting pressure (clearance), i.e., an apparatus for adjusting a distance between the centers of roll shafts.

In such a single facer, suitable urging forces and heating means of the glues must be provided to laminate the corrugating medium 5 with the liner board 6 by applying glues, and consequently an apparatus for withdrawing (circulating) steams to supply heating energy is incorporated in said rolls 1, 2 and 3.

There was a problem as described below in the traditional single facer illustrated in Fig. 1. That is, when a glue is used to laminate the liner board 6 with the corrugating medium 5 which has been formed in a wavy-configuration, a certain heating means is required to heat the starch glue to a flowable state, and hot rolls which has been heated act to elevate the temperature and expand the opposite sides frames 8 on which rolls are supported.

This results, for example, in the increase of the distance P between the centers of shafts of lower and press rolls 2 and 4 which are journaled, and consequently a gap amount S also tends to increase with time. For these shortcomings, urging forces of the press roll 4 are gradually reduced, and such small urging forces may result in the production of the single faced corrugated fiberboard 7 with inconsistent thickness and also in an imperfectly laminated corrugating medium 5 and the liner board 6 from which the single faced corrugated fiberboard sheet are made, and thus a poor quality paper has frequently be made having substantially reduced strength and quality.

The problem in the prior art has been described with reference to the lower roll 2 and the press roll 4, but similar problem of varying the distance between the centers of roll shafts may also occur between the top roll 1 and the lower roll 2, or between the lower roll 2 and the gluing roll 3, as the temperature of the frame 8 is elevated, and this has been a significant factor to block the improvement of the apparatus toward automation. Therefore, it has been a common practice to check the corrugated fiberboard 7 which is being produced for any abnormality through a visual inspection, and then to manually remove any defect if any. This procedure, however, needs a high level of skills and experiences,

which blocks automation.

3. OBJECT AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a single facer which can maintain a gap between rolls at constant by automatically correcting a distance between the centers of roll shafts.

To achieve the above object, the present invention provides a single facer apparatus for forming single-face corrugated sheets having a top corrugating roll, a lower corrugating roll, a gluing roll and a press roll supported on a frame and passing a sheet medium to be corrugated between said lower corrugating roll and each of said top corrugating roll, said gluing roll and said press roll, and heating means for heating each of said rolls, the improvement comprising a means for adjusting the distance between centers of support shafts of said lower corrugating roll and at least one of said top corrugating roll, said gluing roll and said press roll; a temperature sensor means for detecting the expansion of said frame caused by transfer of heat from said rolls by detecting the temperature of said frame or a sensor to detect the start of the heating operation of the heating means; and a controller for actuating said means for adjusting in response to the detection of expansion by either said temperature sensor means or said sensor in order to compensate for said expansion of said frame by maintaining the distance between said centers of support shafts constant.

~~away from said lower roll, said apparatus being operable~~ to move the roll which is arranged for movement toward and away from other roll by actuating driving means, said frame is provided either with a temperature sensor which senses the temperature of the frame or a sensor which senses the start of the heating operation of the heating means, and furthermore a controller is provided which can actuate said apparatus for correcting the distance between centers of roll shafts in response to detection signals ~~from the sensor.~~

Thus, the inventor of the present invention has found that the temperature of the frame is increased with time as hot steams are caused to circulate within each of rolls, and that there is a certain interrelationship between the temperature of the frame and the gap amount of the lower roll. When the steam valve is opened, the temperature of the frame may increase in a curved fashion, and the gap amount between said rolls may also increase proportionally. It is also found that the temperature of the frame may cease increasing further at a predetermined time and therefore the temperature is kept at a constant level, and the gap amount become steady after the passage of the predetermined time. Such tendency has been substantially common to the same single facer.

Taking the above phenomenon (tendency) into accounts, the present invention has been made such that a temperature sensor is utilized to measure the temperature

variation of the frame, and an apparatus is driven via a controller for correcting the distance between centers of roll shafts so as to maintain a gap amount at a constant level. Furthermore, because the temperature increase of the frame may be taken as a function of the passage of time, a timer is preset so that the apparatus for correcting the distance between the centers of roll shatfs may be actuated in response to the passage of the preset time, instead of the variation in the frame temperature, and thereby maintaining the gap amount between rolls at constant.

As afore-described, the present invention is constituted such that the variation in the distance between the centers of roll shafts may be detected either as a function of the passage of time or by directly measuring the frame temperature, and the apparatus for correcting the distance between the centers of the roll shafts may be controlled in response to such temperature variation, and thus a precise correction is achievable for the expansion (increase in the gap amount between the lower roll and the press roll and the like). As a result, it is possible to eliminate inconsistent lamination between single faced corrugated fiberboard sheets and the like, providing a remarkable effect in the improvement of the product quality such as thickness, strength and aesthetical appearance etc., moreover, it is not needed to stop operating the single facer to adjust the contact

pressure between rolls, and besides numerous other merits are derived such as an automatic operation.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a concentional view showing a typical single facer in a prior art;

Fig. 2 is a lateral cross-sectional view showing the single facer embodying the concept of the present invention;

Fig. 3 is a partial cross-sectional view showing a press roll section in the single facer in accordance with the present invention;

Fig. 4 is a front elevation showing essential parts of the apparatus for adjusting a distance between the centers of the shafts of the press roll and the lower roll;

Fig. 5 is a diagrammatic view showing a relationship between the passage of time after hot steams are caused to circulate in each of rolls, the gap amount between rolls and the frame temperature; and

Fig. 6 is a view showing an alternative mode of operation of the apparatus for adjusting the distance between the centers of the roll shafts.

5. DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A single facer is constituted as shown in Fig. 2 by a top roll 11 having teeth 11a formed around the circumfernetial surface, a lower roll 12 having teeth 12a formed around the circumferential surface with said teeth 12a engaged teeth 11a of the top roll 11, a gluing roll 13

arranged to be closely adjacent to teeth 12a of said lower roll 12, and a press roll 14 and the like arranged to be closely adjacent to or in contact with teeth 12a of the lower roll 12. The lower roll 12 has its bearings pinched and fastened in place between the frame 15 and the bracket 16. The top roll 11 is supported via bearings (not shown) on an arm 17 one end of which is attached to the frame via a pivot pin 18 for free pivotable movement and an opposite end of which is coupled with the piston rod tip end of the pressure cylinder via a pin 20. The pressure cylinder 19 is supported on the bracket 16 which is in turn fastened with the frame 15. A positioning stop (not shown) is used in conjunction with the cylinder 19 to adjust a contacting pressure (gap) between two rolls 11 and 12.

As shown in Fig. 3, the shaft 14a of the press roll 14 is journaled on bearings 22 opposite ends of which are embraced by an eccentric disc 21 which is held on the frame 15 via a bush 23 for pivotal movement. A press lever 25 is secured via a tapered pin 24 on the eccentric disc 21. An eccentricity adjustment rod 26 is provided to be closely adjacent to one end of the press lever 25. As shown in Fig. 4, the eccentricity adjustment rod 26 has its opposite ends journaled on the frame via a slide bush 27 for axial slidable movement. Furthermore, a female thread 26a is formed on an outside end of the said rod 26 and threadably engaged with a thread rod 28. A portion of the thread rod 28 is journaled on the bracket 39 through

bearings 29 and the top end of the rod 28 is directly coupled through a coupling 32 with the shaft 31a of the motor 31 which is secured on the bracket 32. The motor 31 is controlled as described below in response to the temperature sensor 33 provided on the frame 15, and connected with the temperature sensor 33 through the controller 34. An inclined slider 35 is secured in place on said rod 26 where it corresponds with the bearing section of the press roll 14, and as the rod 26 slides in an axial direction the press lever 25 and the eccentric disc 21 are caused to pivot by means of the slider 36 which is in sliding contact with the inclined surface 35a of the slider 35, and thereby shifting the position of the center c of the press roll shaft 14a. A cylinder 37 for securing the eccentric disc is arranged between an opposite end of the press lever 25 and the frame 15 as shown in Fig.3. The cylinder 37 urges the press lever 25 towards a counterclockwise direction in Fig.3. Thus, the slider 36 which is arranged on one end of the press lever 25 is constantly in abutment with the slider 35. The shaft 13a of the gluing roll 13 is supported on the frame 15 or an arm and the like via bearings. The gluing roll 13 has its lower portion oriented toward and immersed in a glue 39 in a glue container 38. An adjustment roll 40 is arranged above the glue container 38. The adjustment roll 40 functions to suitably adjust the quantity of glues 39 adhered on the gluing roll 13 surface, and has its shaft

40a supported for movement on the frame 15 or an arm and the like via bearings and its circumferential surface in abutment with the gluing roll 13 to scrape away an excess glue 39 adhered on the roll 13.

In such single facer, a single faced corrugated fiberboard sheet is manufactured in accordance with a process wherein the corrugating medium 41 is urged to enter into a gap between rolls 11 and 12, and formed into a corrugated shape under cooperation between two rolls 11 and 12, then the corrugating medium 14 is guided to pass through rolls 12 and 13, the glue 39 is applied over the top portion of the corrugating medium 41 by means of the roll 13, furthermore the corrugating medium 41 and the liner board 41 are overlapped each other between rolls 12 and 14, and finally the liner board 42 is urged against the corrugating medium 41 by means of the roll 14.

During the course of this process, steams are supplied to rolls 11,12 and 14 though the valve 44 with the actuation of the single facer, and these steams act to heat rolls 11, 12 and 14. As these rolls 11, 12 and 14 are elevated in temperature, the heats are transmitted to the frame 15 through bearings and the like. In this manner, as the temperature of the frame 15 increases, the frame 15 is expanded in response to such heats, and as a result distances P between rolls 11 and 12 and between rolls 12 and 14 increase.

Fig. 5 indicates an interrelationship between the

frame temperature T which is variable with the passage of time after hot steams are caused to circulate in rolls 11, 12 and 14 and the gap amount S between the lower roll 12 and the press roll 14. In this graphical illustration, it is indicated that when the steam valve is opened at the time Ha, the temperature of the frame 15 is increased from Ta to Tb after a predetermined period is expired as shown with a solid line, and proportionally the gap amount between said rolls is increased from Sa to Sb. In the meantime, the temperature increase of the frame 15 reaches its peak value after the predetermined time H_b and then the temperature stops elevating further and thereafter a constant temperature T_b is maintained and the gap amount S between rolls is also maintained at constant after the expiry of the predetermined time H_b. This tendency is substantially common to the same single facer.

In the above embodiment, the phenomenon (tendency) is taken into accounts, and the temperature sensor 33 is used to measure the temperature variation of the frame 15 and then the controller is actuated to drive the motor 31 in accordance with the temperature thus measured, and thereby maintaining the gap amount S between rolls 12 and 14 at constant. From the graphical illustration in Fig. 5, it is also known to be possible to take the temperature increase of the frame 15 as a function of the passage of time from Ha to Hb. Thus, as shown in Fig. 6, the gap amount S between the lower roll 12 and the press roll 14 can be

maintained at constant by providing the valve 44 with the sensor 33' adapted to verify the opening of the valve 44, and the output from the sensor 33' is supplied to the controller 34' in which the motor 31 is actuated to operate in accordance with the amount which corresponds with the passage of time in Fig. 5.

Meanwhile, a broken line in Fig. 5 is a curve indicating one example of how variations in the gap may be corrected, and such correcting amount may be freely preset through controllers 34 and 34'.

In the embodiment described above, the apparatus for correcting the distance between the centers of the roll shafts in acordance with the present invention is provided between the lower roll 12 and the press roll 14, but it is also possible to arrange the same apparatus between the lower roll 12 and the top roll 11 and between the lower roll 12 and the gluing roll 13.

The claims defining the invention are as follows:-

1. A single facer apparatus for forming single-face corrugated sheets having a top corrugating roll, a lower corrugating roll, a gluing roll and a press roll supported on a frame and passing a sheet medium to be corrugated between said lower corrugating roll and each of said top corrugating roll, said gluing roll and said press roll, and heating means for heating each of said rolls, the improvement comprising a means for adjusting the distance between centers of support shafts of said lower corrugating roll and at least one of said top corrugating roll, said gluing roll and said press roll; a temperature sensor means for detecting the expansion of said frame caused by transfer of heat from said rolls by detecting the temperature of said frame or a sensor to detect the start of the heating operation of the heating means; and a controller for actuating said means for adjusting in response to the detection of expansion by either said temperature sensor means or said sensor in order to compensate for said expansion of said frame by maintaining the distance between said centers of support shafts constant.

2. A single facer apparatus according to claim 1, wherein said means for adjusting comprises a cam means in contact with a support shaft of at least one of said rolls for adjusting the position of said at least one of said rolls relative to an adjacent roll according to the position angle of said cam means, a lever means for rotating said cam means to a desired angular position, and a means for moving said lever means in response to operation of said means for actuating.

3. A single facer apparatus according to claim 2, wherein said means for moving comprises an inclined slider mounted to an adjustment rod, said means for actuating comprises a motor operable in response to said temperature sensor means, said adjustment rod being movable in an axial direction by rotation of said motor to cause said inclined slider to engage said lever means and thereby rotate said cam means to said desired angular position.

4. A single facer substantially as hereinbefore described with reference to Figures 2 to 6 of the accompanying drawings.

NOVEMBER 6 1992

MITSUBISHI JUKOGYO KABUSHIKI KAISHA

By their Patent Attorneys

KELVIN LORD AND COMPANY

PERTH, WESTERN AUSTRALIA

FIG. 1

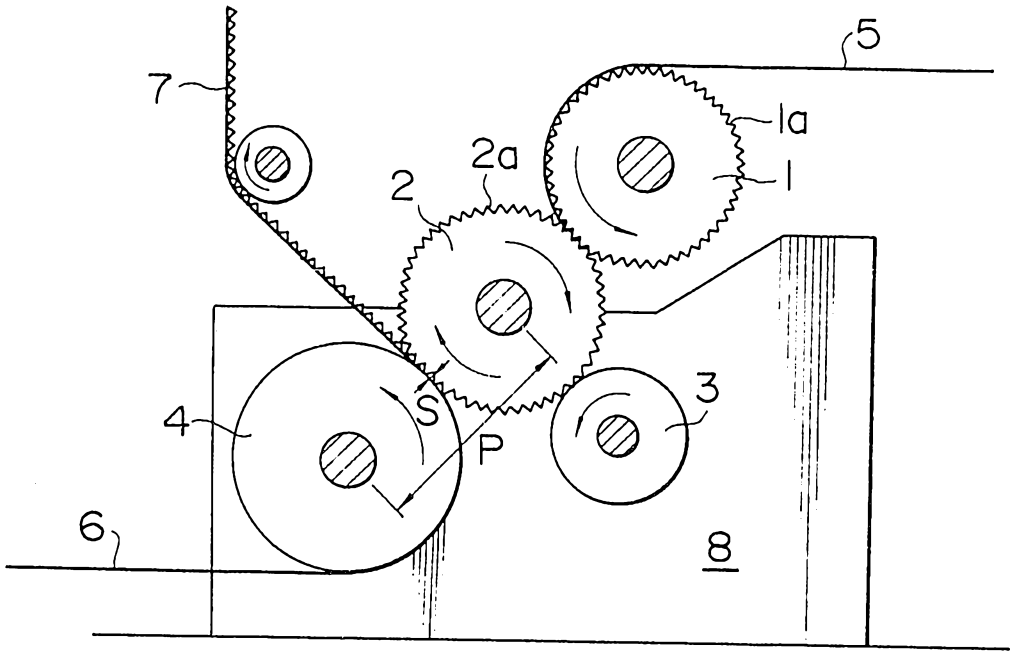
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FIG. 2

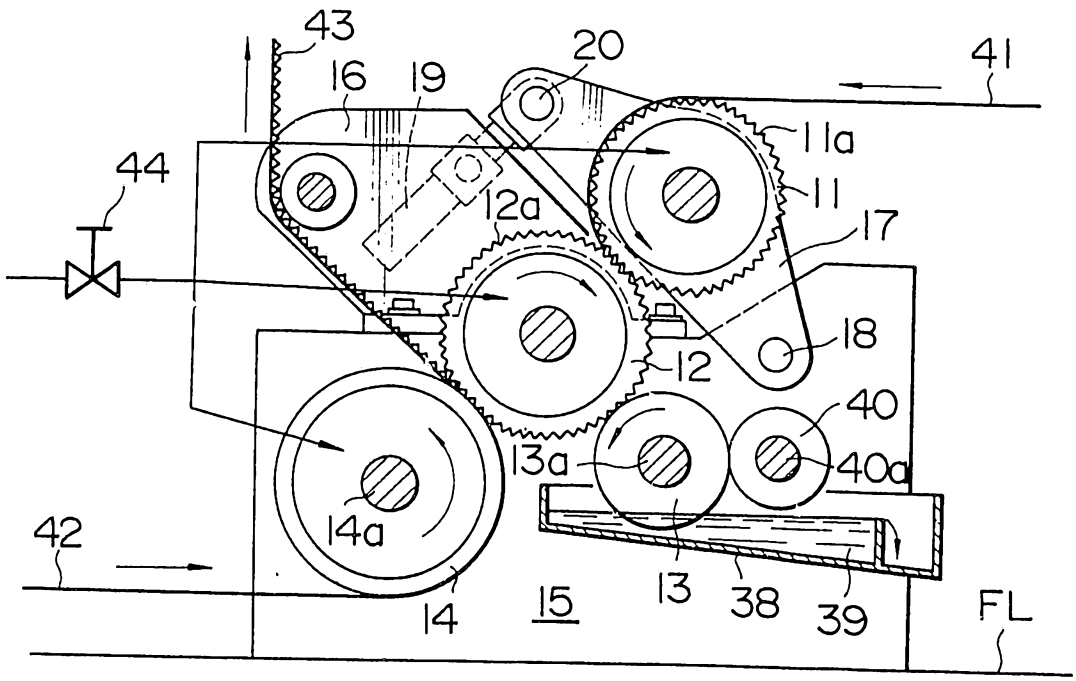
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FIG. 3

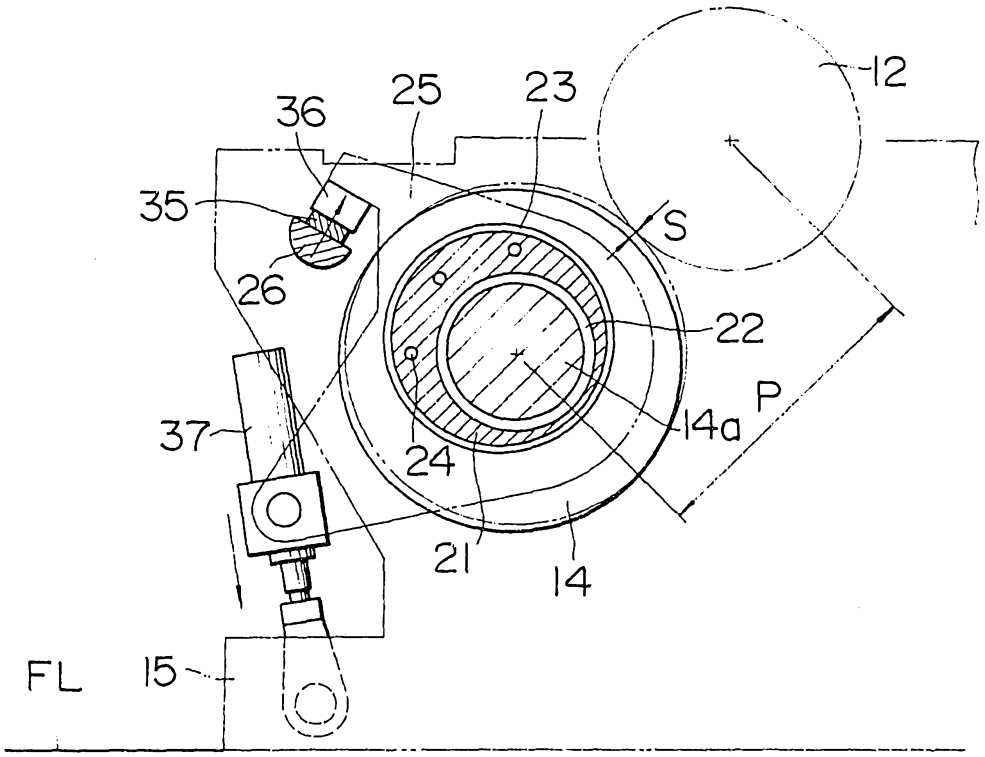
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FIG. 4

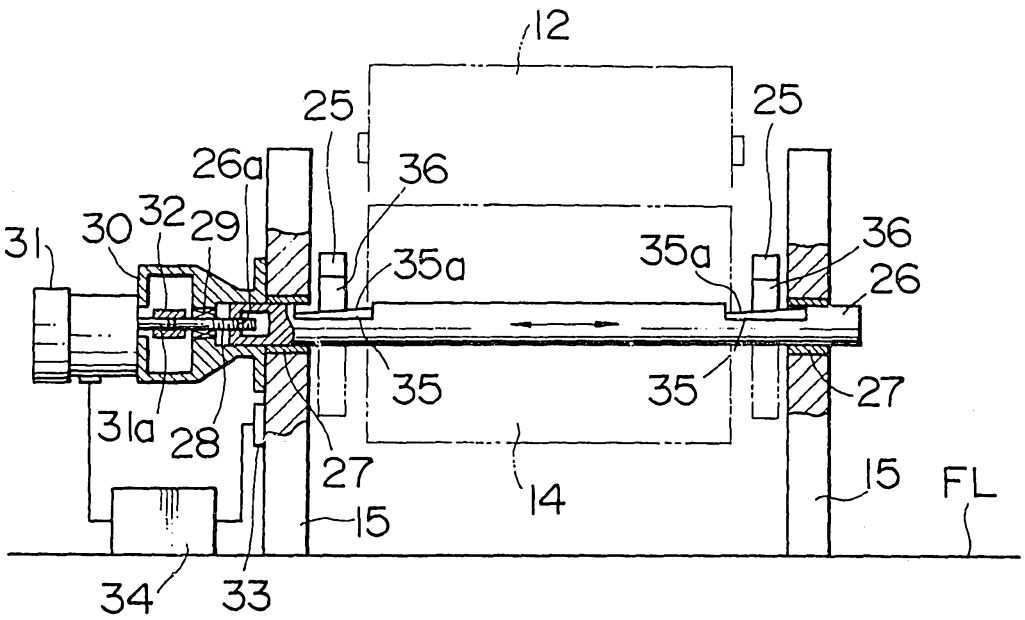
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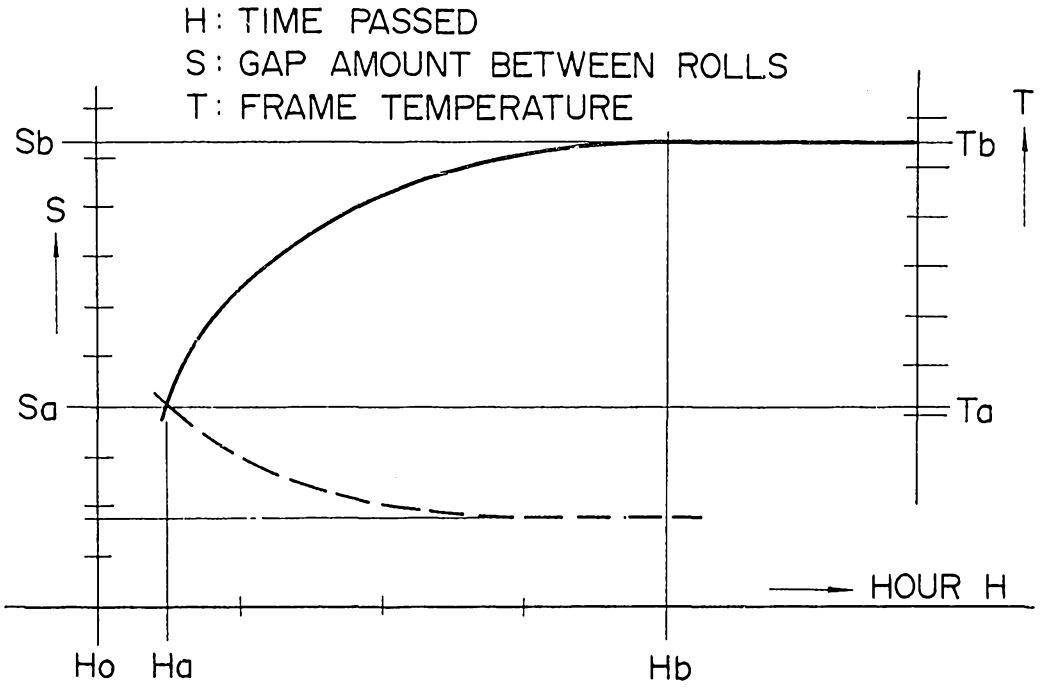
FIG. 5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S: GAP AMOUNT BETWEEN ROLLS
T: FRAME TEMPERATURE
Sb
S
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Tb
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Ha
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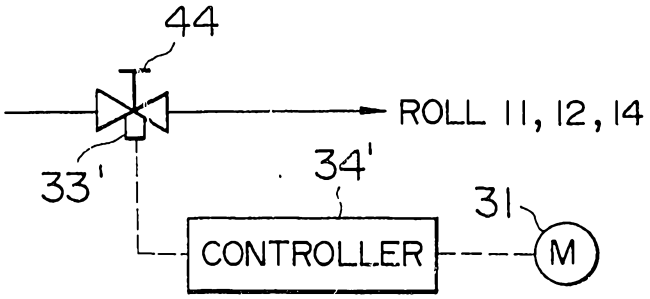
FIG. 6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