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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : D21B 1/06 — A1

(11) International Publication Number: WO 94/28233

(43) International Publication Date: 8 December 1994 (08.12.94)

(21) International Application Number: PCT/GB94/01098

(22) International Filing Date: 20 May 1994 (20.05.94)

(30) Priority Data:
08/066,544 24 May 1993 (24.05.93) US

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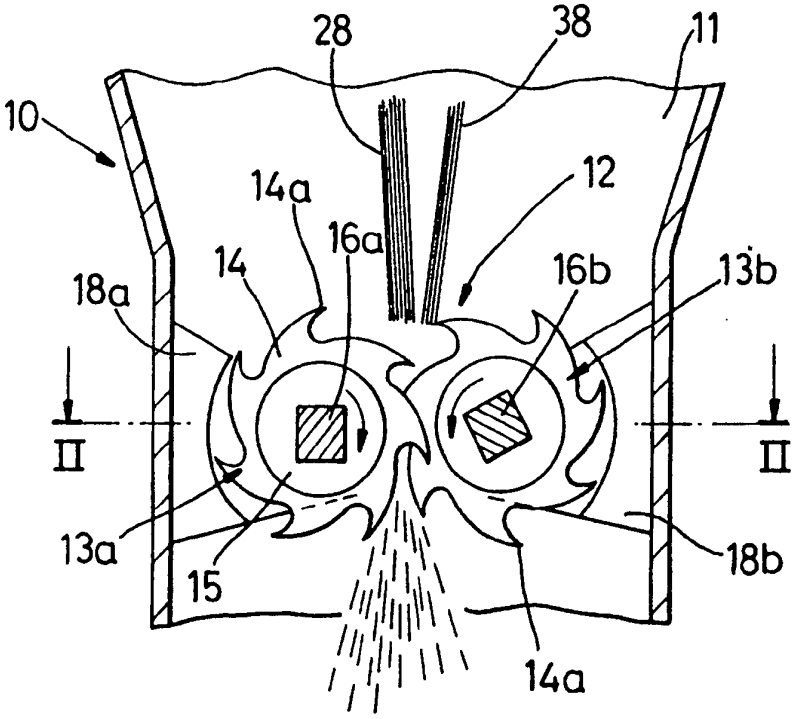
(81) Designated States: AT, AT (Utility model), AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DE (Utility model), DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TT, UA, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: IMPROVEMENT IN COMMINUTING WOOD PULP SHEETING

(57) Abstract

Wood pulp sheeting used as feedstock in a cellulosic fibre production plant is comminuted by hooking laminated platelets of wood pulp from a pluri-layer web of such sheeting and agitating the platelets in a fan generating a conveying gas stream to delaminate the platelets and individually separate them into torn pieces of wood pulp sheeting.



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IMPROVEMENT IN COMMINUTING WOOD PULP SHEETING

This invention relates to a method of creating a comminuted feedstock for use in a processing plant and has particular, but not exclusive, reference to cellulose-based feedstock materials which may be used, inter alia, in the production of cellulosic material such as film, tube and fibres.

It is known to use wood fibres as a feedstock for a variety of different industrial processing plants. The wood fibres can be supplied to users in the form of rolls of wood pulp sheet material which may have to be broken down into small pieces as an initial stage in the process. This invention is concerned with the method of carrying out a breaking down of wood fibre sheet material to produce small pieces for subsequent processing.

Wood pulp is commonly supplied to end users in roll form, each roll being categorised with reference to at least one particular property of the sheet material, the end user selecting which roll to use for the creation of a feedstock on the basis of an assessment of the value of the particular properties assigned to the rolls that are currently available for use as feedstock. The invention has particular, but not exclusive, application to the situation where an eventual feedstock required for subsequent processing is created by mixing together small pieces removed from the sheet material drawn from a number of different rolls.

According to one aspect of the invention a method of creating a comminuted wood fibre feedstock from at least one sheet of wood pulp includes feeding the at least one sheet into a cutting area defined by a nip created between first and second rows of contra-rotating disc cutters, at least one row being provided with hooks to drag material between the rows of cutters through the nip and thereby to tear

platelets or pieces out of the sheet, and receiving the torn platelets downstream of the nip and forwarding them pneumatically to the processing plant.

Suitably the disc cutters in each row are alternated with spacers, the disc cutters and spacers in the first row interdigitating with the spacers and disc cutters in the second row.

Conveniently, each disc cutter has a plurality of hooks. Suitably there are more than four hooks on each cutting disc, preferably between five and ten hooks and more preferably seven hooks. Each spacer can be of comparable thickness to the disc cutters used and a thickness between 20 and 40 mm, preferably around 30 mm, is very suitable.

Each row of cutters and spacers is desirably supported on a shaft extending across the entire length of the cutting area. The shafts can be driven at the same speed suitably from a pair of electric motors.

Static combs can be provided with tines that locate between the disc cutters and spacers in each row, the individual tines of each comb being disposed below the respective shafts and projecting from an edge of an outlet opening of the cutting area towards the centre thereof. The combs ensure that the only exit from a hopper feeding the cutting area is between the two rows of disc cutters and prevent torn material leaving the cutting area being drawn back up into the hopper, and stop material going through the shredder twice.

Preferably, following comminuting by two rows of interdigitating disc cutters and disc spacers, the torn pieces are fed into a fan which transports them pneumatically downstream to a further processing stage and mechanically agitates the torn pieces to ensure they are separated in preparation for subsequent treatment (e.g. with

liquid).

Suitably the wood pulp is fed into the cutting area as a pluri-layer web comprising "n" sheets of wood pulp laid one on the other. More suitably the wood pulp is fed to the cutting area as two or more different pluri-layer webs of wood pulp sheeting.

Each layer in a pluri-layer web of "n" different layers of sheet material may be selected with regard to some known parameter property of the wood pulp whereby the pluri-layer web has an aggregate value of the selected parameter property which lies within a chosen range of values of said parameter property. Conveniently where the feedstock is created by comminuting two or more different pluri-layer webs to create a mass of comminuted pieces of sheet material, there are different numbers of layers in each web.

A pluri-layer web of "n" layers of sheet material laid one on the other can be created in apparatus having a roll stand supporting a plurality of different stock rolls of wood pulp sheet material in side-by-side relationship, with means for drawing sheet material from each of said stock rolls to form a pluri-layer web with "n" layers of sheet material disposed one on another, and with means defining an output of the apparatus through which said pluri-layer web can be forwarded to the cutting area.

Typically "n" is between 4 and 12.

In the production of cellulosic fibres it is known to use as raw material broken pieces of wood pulp sheet material. The subsequent processing can be critically dependent on the aggregate properties of the mass of broken pieces. This invention, in its different aspects, relates to a novel way of producing a mass of broken pieces of wood pulp sheeting of the required aggregate properties.

In the case of stock rolls of sheet-formed wood pulp, suppliers grade the sheet-formed material on a roll, inter alia, on the basis of the viscosity of a liquid product produced in a pre-determined manner from the wood pulp and supply the roll to the end user with a viscosity rating. The end user can then select, from the range of stock rolls available, those having viscosity ratings which he wishes to use for a particular feedstock material.

Desirably, prior to creating a comminuted feedstock material from a plurality of different stock rolls of wood pulp sheet material of selected viscosity rating, the sheet materials from a number of stock rolls are drawn together to create a pluri-layer web which is fed as such to a pulp mill where the web is torn between contra-rotating disc cutters to create the required feedstock material at the output of the mill.

By the simple expedient of tearing laminated platelets out of a pluri-layer web between contra-rotating disc cutters and subsequently separating the platelets into individual pieces, we have found it possible to simplify the manufacture of feedstock and to exercise greater control over the production of the required feedstock material.

In a preferred arrangement, two or more separate pluri-layer webs are created utilising a separate roll stand for each web, the feedstock material being created by feeding to the pulp mill a pre-selected ratio of web material taken from one stand to web material taken from another stand.

Desirably a first roll stand carries only stock rolls having a viscosity rating in a lower value (hereafter referred to as "LV") band and a second roll stand contains only stock rolls having viscosities in a higher value (hereafter referred to as "HV") band, the comminuted feedstock being created by breaking up, in the cutting area, pluri-layer webs taken from both roll stands.

If the comminuted feedstock is to be used in the creation of cellulosic fibres we have found it to be important to control not only the aggregate value of the viscosity rating of an LV web fed to the cutting area but also the viscosity rating of a HV web fed to the cutting area and to control the proportion of the LV to HV webs in the final comminuted feedstock material produced.

Where just two roll stands are used it is convenient to have different numbers of stock rolls in each stand. One convenient arrangement is for there to be $^{2p}/_{3}$ layers of sheet material in the web leaving an LV roll stand and $^{p}/_{3}$ layers of sheet material in the web leaving a HV roll stand, p being an integer number which is a multiple of 3 and which is not less than 6. p equal to 12 has been found to be a particularly convenient arrangement.

In the or each roll stand, the sheet material from each stock roll can be fed into an unwinding station comprising a pair of rollers each contacted only over part of its circumference by the unwinding sheet material, the downstream roller of each pair defining an advance path for the composite web created in that roll stand. One of the rollers in each pair can be linked to a motion sensing means to detect when the sheet material in that unwinding station is no longer advancing e.g. due to breakage of the sheet material or expiry of the material on that stock roll.

Conveniently the advance path of the pluri-layer web created in the or each stand is disposed below all the stock rolls in that stand. The outlet of the or each roll stand can be provided by a pair of rollers defining a nip, one or both of said nip-defining rollers being driven to advance the web and thereby to draw sheet material off each of the stock rolls providing input for the web, through the outlet nip and into the cutting area where the rotating discs can simultaneously tear all layers together into a mass of separated torn pieces.

A suitable size for the torn pieces would be between 3 and 30 cm^2 if the subsequent processing involves the creation therefrom of a viscous dope for subsequent spinning in a fibre bath. Pieces of a size of between 2 and 20 cm^2, particularly around 5 to 15 cm^2, are preferred.

By tearing or shredding the multi-layer web of pulp sheetings between relatively slowly rotating disc cutters equipped with tearing teeth it is possible to create the separate multi-layer platelets without significant edge compression appearing thereon or on the pieces separated subsequently. Edge compression produces a localised increase in density which in turn affects the reaction rate of a subsequent processing stage in which the comminuted pieces are treated with liquid.

Any tendency for the laminated platelets torn from a pluri-ply web to remain pinched together in pluri-layer form can be overcome by agitating the torn platelets downstream of the pulp mill and we have found that a particularly convenient method of achieving this agitation is to arrange for the torn platelets to be pneumatically conveyed by a rotary fan through which the torn platelets pass and by the rotor of which fan the torn platelets are contacted. A centrifugal fan rotating at some 1800 rpm can be used with great effect to achieve separation of the pieces torn from a laminated platelet. The edges of the blades of the rotor contacted by the stream of dry pulp pieces passing through the casing of the fan can be reinforced to reduce wear thereon.

One embodiment of apparatus for carrying out a method in accordance with this invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic sectional side elevational view of the cutting area of a pulp shredder designed to operate

in accordance with the invention,

Figure 2 is a section on the line II-II of Figure 1 through the cutting area of the shredder shown in Figure 1,

Figure 3 is a schematic view of two roll stands designed to feed pluri-layer webs as input to the pulp shredder shown in Figures 1 and 2,

Figure 4 is an enlarged view of the outlet end of one of the roll stands shown in Figure 3 showing the pluri-layer web created as a precursor for the comminuted feedstock material,

Figure 5 is a schematic plan of a pluri-layer web leaving a roll stand, and

Figure 6 is a plan of one piece torn from a web by the mill of Figures 1 and 2.

Figures 1 and 2 show a suitable pulp mill 10 for producing torn pieces from a web of wood pulp sheeting fed into the mill.

A hopper 11 receives the sheeting from above at a preset advance speed and conveys it into a cutting area 12 defined by two rows 13a, 13b of interdigitated disc cutters 14 and disc spacers 15 defining a nip. The cutters 14 and spacers 15 in each row are fixedly supported on a respective rotatable shaft 16a, 16b, each shaft being driven by a separate electric motor 17. The two motors drive the shafts in opposite directions (see Figure 1) so that hooks 14a on the cutters tear pieces from the web advancing through the hopper 11, passing the torn pieces downwards through the nip into an outlet of the mill 10.

As shown, each disc cutter has seven teeth 14a but other arrangements of teeth are possible.

The width of each disc cutter 14 (i.e. the dimension in the axial direction of the shaft) and the speed of advance of the web of sheet material into the cutting area determine the size of the platelets torn from the web and the arrangement shown has cutters and spacers each of a width of 31 mm, this producing platelets with one dimension which is about 30 mm. The other dimension depends on the web advance speed but in a typical case pieces (see Figure 6) 40 of a size around 10 cm^2 would be preferred.

Tines 18 of combs 18a, 18b interdigitate between the cutters 14 and spacers 15 on the downstream side of the cutting area 12 to prevent web material leaving the hopper 11 other than through the gap available between the two rows 13a, 13b and to clear torn pieces from the cutting teeth.

The disc cutters 14 have an overall diameter of 260 mm and the spacers a diameter of some 160 mm. Each shaft 16a, 16b is driven at a speed of some 140 rpm. A processing rate of some 24 metres of web a minute is possible.

The length of the hopper 11 is desirably slightly in excess of the width of the web fed to it and in the case of webs of a width of 1 metre, a hopper length of some 1070 mm has proved to be suitable this providing some 17 disc cutters in each row (34 cutters in all).

A particularly suitable pulp shredding mill 10 is based on the Birkett Cutmaster AZ45 machine marketed in the United Kingdom by Carclo Engineering Group PLC.

Figure 3 shows part of a wood pulp processing plant showing an LV roll stand 20 and an HV roll stand 30, each roll stand feeding its respective output web to the pulp mill 10.

The LV roll stand 20 comprises eight stock rolls 21a..21h each feeding sheet material 22a..22h downwardly to

a pair of idler rollers 23a, 24a..23h, 24h.

The outlet end of the LV stand 20 is defined by a nip created between a roller pair 25, 26 which frictionally engages the web created from the eight layers of sheet material 22a..22h. Both rollers 25, 26 are suitably driven to create a desired web advance speed and create the driving traction for withdrawing sheet material from each of the stock rolls 21a..21h.

To control the path of the sheet from a respective stock roll to the line of advance of the web, idler rollers 23a..23h and 24a..24h each bear against the respective sheet in contact with it over part only of its circumference, this degree of contact being sufficient to ensure that, under normal circumstances, there is negligible slippage between the advancing sheet material and at least the respective upper roller 23a..23h. A motion sensing device (shown schematically at 27a..27h) is connected to each of the rollers 23a..23h, these sensing devices being used to determine when sheet material is not being advanced from the respective stock roll e.g. because a breakage has occurred or the stock roll in question has become exhausted of sheet material.

The HV roll stand 30 is similarly constructed to the LV roll stand and for convenience the reference numbers 31 - 37 have been used to correspond to the numbers 21 - 27 used in the description of the LV roll stand. It will be noted, however, that there are only four stock rolls on the HV stand so that "d" is the highest reference letter used in connection with the individual stock rolls in the HV stand. The nominal eight-layer web leaving the LV stand 20 has been given the reference number 28 and the nominal four-layer HV web leaving the stand 30 has been given the reference number 38. These pluri-layer webs 28 and 38 are fed together to the pulp shredder described earlier with reference to Figures 1 and 2 but schematically illustrated in Figure 3 by

the reference number 10.

Since the two roll stands are independent with their own nip pair 25: 26 and 35: 36, the relative speeds of advance of the two webs 28 and 38 can be independently selected to give a desired final feedstock composition in the comminuted material leaving the pulp shredder 10

Figure 4 shows in side elevation and Figure 5 shows in plan, the composite web 28 leaving the LV stand 20. Eight layers 22a to 22h are shown in Figure 4 but only seven layers in Figure 5, web layer 22d being missing due to exhaustion of material from the stock roll 21d.

Figure 6 shows a torn off piece 40 of one layer of one of the webs 28, 38 fed to the pulp mill or shredder 10. This piece has an area of around 10 cm^2 and is characterised by being torn from the layer it formed in a manner which does not cause it to permanently adhere to pieces torn from adjacent layers and which ensures there is no (or no significant) compression of the edge regions defining the torn periphery of the piece 40. The absence of adherence between pieces is important in the case of the output of the mill 10 going on to a continuous process plant (although it is less important in a batch processing plant where local inhomogeneities within a batch are not usually significant). The absence of any significant edge compression of the piece 40 facilities subsequent processing where digestion of the piece in a liquid occurs.

Any temporary adherence between pieces 40 making up a laminated platelet torn from a pluri-layer web can be destroyed by agitating the platelets in the casing of a cutter fan 50 which is used to suck the torn platelets of pieces 40 away from the mill 10 and convey them pneumatically to some downstream processing unit 51 producing fibre 55.

The fan 50 can be of the sort used in a waste disposal role to receive trimmed off edge strip from a paper- or film-making machine and to break up the strip into pieces for easier disposal. The cloud of torn platelets from the mill 10 can be led to the central region of the rotating rotor of a centrifugal fan 50 and in moving radially out to the tangentially disposed fan outlet is agitated by the blades of the rotor. The level of agitation can be controlled by the design of the rotor and its cooperating casing and by the speed of rotation. It is possible to provide a further size reduction of the separated pieces 40 in the cutter fan 50, but normally agitation at a level sufficient to break the torn platelets into individual layer pieces 40 is all that is required.

When the method of the invention is being used to create feedstock from a HV pluri-layer web 38 and a separate LV pluri-layer web 28, it is normal to have the HV web advancing into the hopper 11 at a slower rate than the LV web. This has the result of producing smaller pieces from the HV web than from the LV web and this mix of sizes can be convenient in the subsequent treatment of the feedstock produced.

The foregoing represents one embodiment of the invention and it should be appreciated that other arrangements are possible within the scope of the following claims.

CLAIMS

1. A method of creating a comminuted wood fibre feedstock from at least one sheet of wood pulp for use in a cellulosic solution production plant, characterised in that the method includes

(a) feeding the at least one sheet into a cutting area (12) of a shredding mill (10) defined by a nip created between first and second rows of contra-rotating disc cutters (14), at least one row being provided with hooks (14a) to drag material between the rows of cutters through the nip and thereby to tear platelets out of the sheet, and

(b) receiving the torn platelets downstream of the nip and forwarding them pneumatically to the processing plant (51).

2. A method according to claim 1, characterised in that the wood pulp is fed into the cutting area as a pluri-layer web (28, 38) comprising between 4 and 12 layers of wood pulp sheeting laid one on another.

3. A method according to claim 1 or 2, characterised in that the wood pulp is fed to the cutting area as at least two different pluri-layer webs of wood pulp sheeting.

4. A method according to claim 3, characterised in that there are $^{2p}/_{3}$ layers of sheet material in the first web and $^{p}/_{3}$ layers of sheet material in the second web, p being an integer number which is a multiple of 3 and which is not less than 6.

5. A method according to claim 1, characterised in that the method also includes the steps of:

(c) mounting a plurality of rolls of wood pulp sheet material of a first range of properties in a first roll stand (20),

(d) drawing sheet material off each roll (21a-h in the first roll stand (20) and laying the sheet materials one on

the other to create a first pluri-layer web (28), and

(e) withdrawing the first pluri-layer web from the first roll stand and leading it to the cutting area of the shredding mill.

6. A method according to claim 5, characterised in that a second roll stand (30) is provided to create a second pluri-layer web (38) and said first and second webs are fed together into the cutting area (12) of the shredding mill.

7. A method according to claim 3, 4 or 6, characterised in that the first pluri-layer web (28) is made up of sheet materials having viscosity ratings in a first band of viscosities and the second pluri-layer web (38) is made up of sheet materials having viscosity ratings in a second band of viscosities which is higher than said first band.

8. A method according to claim 7, characterised in that the rate of advance of the second web to the cutting area is lower than the rate of advance of the first web to the cutting area.

9. A method according to any preceding claim, characterised in that the method further includes the steps of:

(f) receiving the torn platelets downstream of the nip in the casing of a fan (50) having a bladed rotor turnably mounted in the casing,

(g) drawing the torn platelets through the casing by pneumatic flows created by the bladed rotor, and

(h) breaking up the torn platelets in the casing by engagement with the bladed rotor to form separate pieces of the wood pulp.

10. A method according to any preceding claim, characterised in that the torn platelets of wood pulp have an area of between 2 and 20 cm^2.

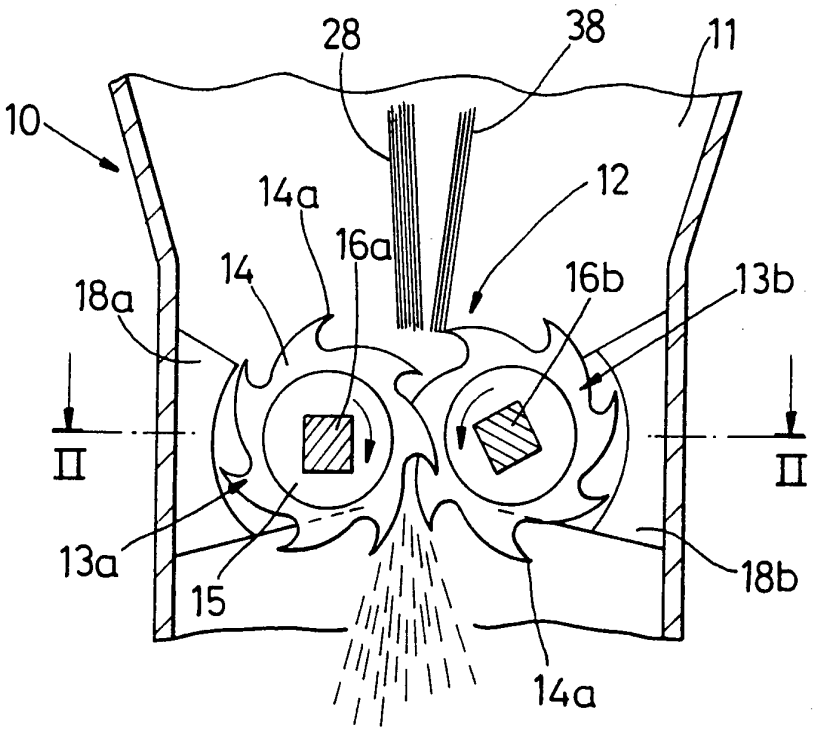

28
38
11
10
14a
12
16a
14
16b
13b
18a
II
II
13a
15
18b
14a

Fig. 1

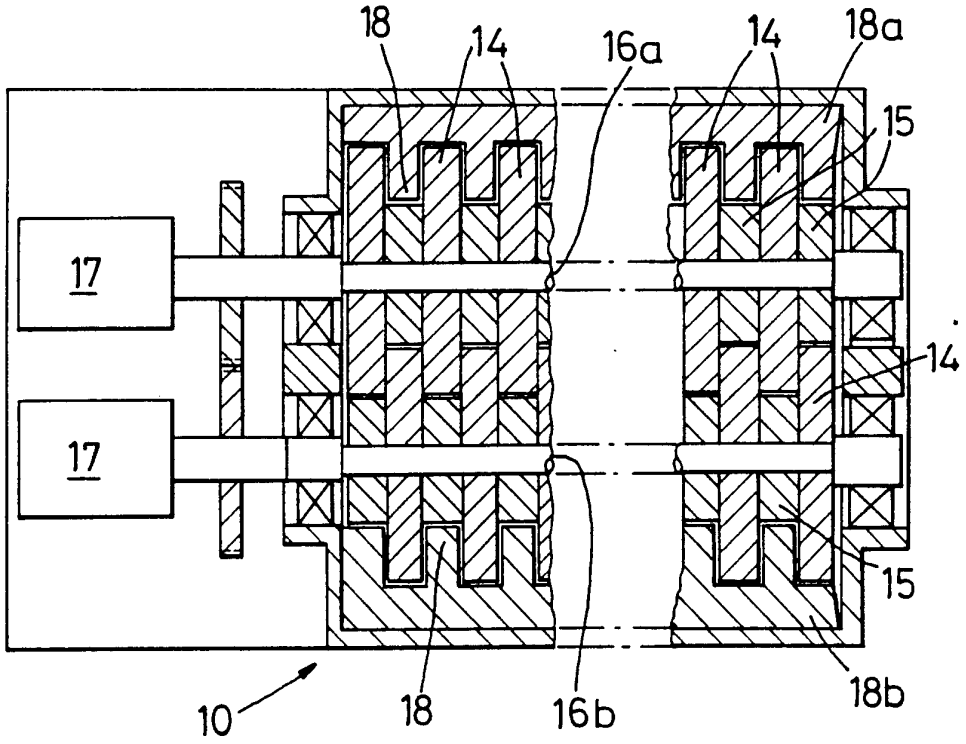
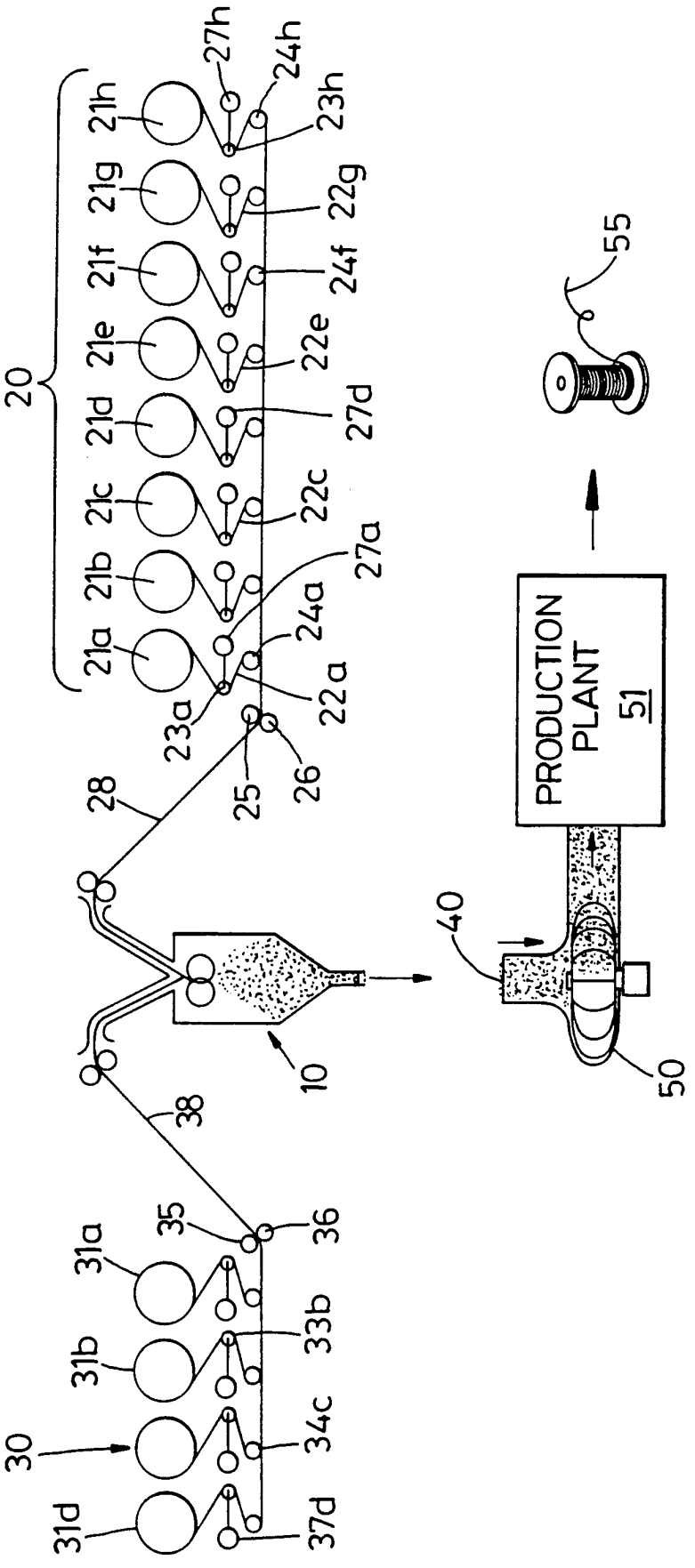

18
14
16a
14
18a
15
17
17
14
15
10
18
16b
18b

Fig. 2


20
21a
21b
21c
21d
21e
21f
21g
21h
22a
22c
22e
22g
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24a
24f
24h
25
26
27a
27d
27h
28
10
38
30
31a
31b
31d
33b
34c
35
36
37d
40
50
55
PRODUCTION PLANT 51

Fig. 3

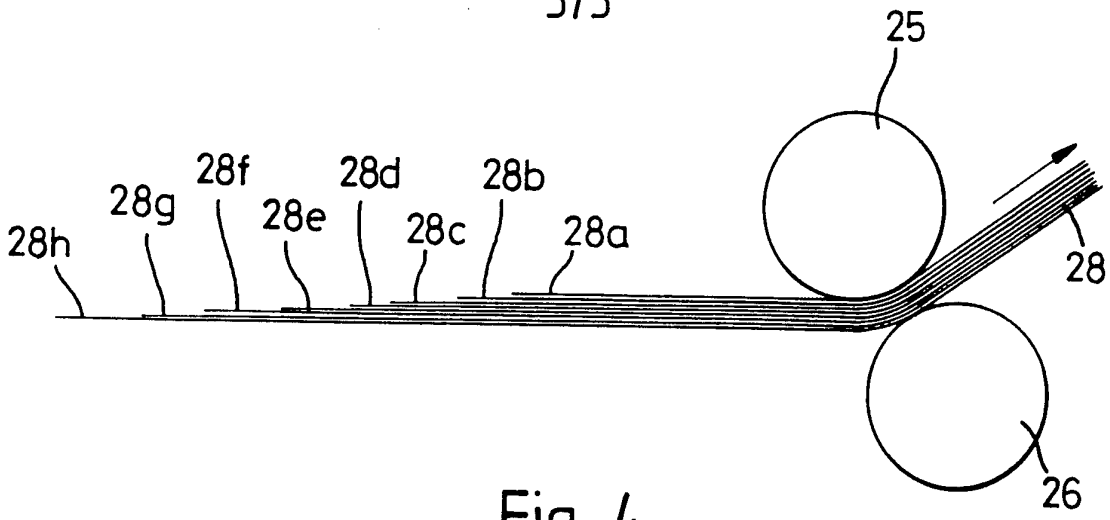

Fig. 4

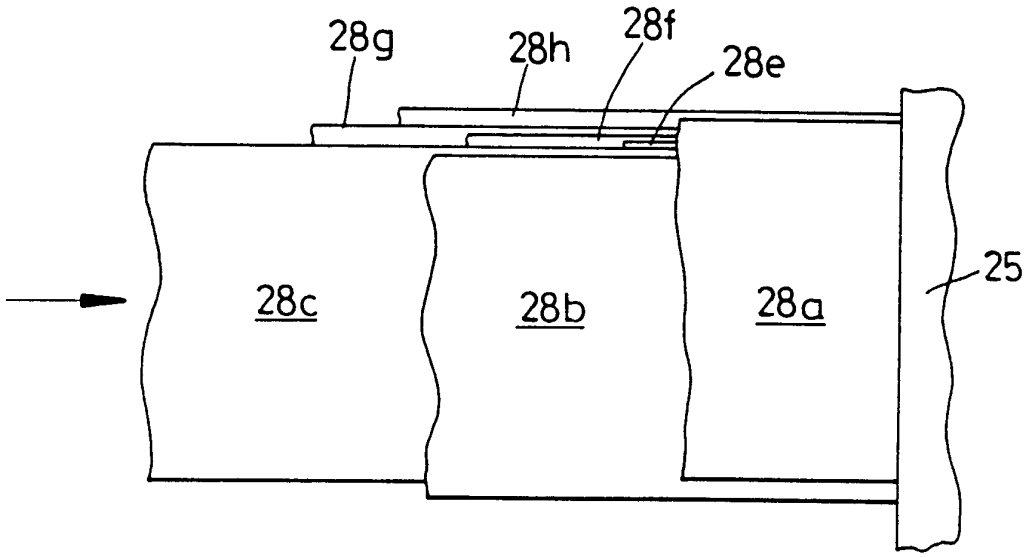

Fig. 5

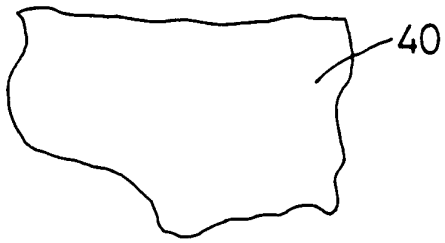

Fig. 6

INTERNATIONAL SEARCH REPORT

Interna ul Application No
PCT/GB 94/01098

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 D21B1/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 D21B D01F C08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,C,113 079 (OFFENE HANDELSGESELLSCHAFT W. SIEDERSLEBEN & CO.) 4 September 1900 see the whole document ---	1-10
A	US,A,2 292 901 (WILLIAM RICHARD SCHMITZ JR.) 11 August 1942 see the whole document -----	1-10

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 September 1994	13. 10. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Tarrida Torrell, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
PCT/GB 94/01098

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C-113079		NONE	
US-A-2292901		NONE	