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(54) **Newsprint furnish and newsprint paper.**

(57) Newsprint papers containing dry-fiberized ink-containing secondary fiber sources exhibit good brightness and low ink speck levels.

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NEWSPRINT FURNISH AND NEWSPRINT PAPER

In the manufacture of newsprint, the newsprint furnishes generally contain virgin chemical and mechanical pulps with relatively minor quantities of secondary fiber. When using conventional secondary fiber for newsprint furnish, it is necessary to first deink the secondary fiber to minimize undesirable dirt specks which appear in the final newsprint paper. The deinking process naturally adds additional cost to the newsprint furnish preparation. In addition, many secondary fiber sources which contain quality fibers also contain inks, toners or other coatings which cannot be readily deinked by conventional wet deinking methods and heretofore have been unavailable for newsprint manufacture.

Therefore there is a need to be able to economically use secondary fiber sources, including those difficult-to-deink secondary fiber sources, for newsprint manufacture, while at the same time avoiding undesirable dirt specks and poor brightness.

In one aspect, the invention resides in a novel newsprint furnish comprising substantially discrete fibers and ink-containing fines produced by substantially dry mechanical fiberization of a secondary fiber source. In a further aspect, the invention resides in a newsprint paper manufactured from this newsprint furnish.

It has been unexpectedly discovered that substantially dry fiberization of secondary fiber sources produces ink-containing fines of such a small size that their presence in a newsprint furnish is not unacceptably detrimental to the quality of the resulting newsprint paper. Hence there is no need to deink by separating the ink-containing fines from the fibers, thereby resulting in a significant cost savings in processing costs as well as material costs. In addition, this discovery permits the use of certain inexpensive secondary fiber sources previously unusable for making newsprint paper because they could not be deinked by conventional wet deinking methods. Hence there is also a significant cost savings associated with the use of relatively inexpensive sources of quality secondary fibers.

The sizes (equivalent circular diameter) of the ink particles of ink-containing fines to be obtained from the dry fiberization for purposes of this invention are substantially within the range of about 70 μm or less. It is preferred that all of the particles be less than about 100 μm , and most preferably less than about 150 μm . Particles larger than about 150 μm are readily individually detected by the human eye at reading distances, whereas those smaller than about 150 μm contribute to decreased brightness.

For purposes herein, "secondary fiber source" means cellulosic products bearing or containing ink, such as printed wastepaper, reclaimed for use as a source of papermaking fibers. Particularly useful secondary fiber sources include computer printout papers, white ledger papers, and non-impact printed papers.

"Substantially discrete fibers" means essentially individual fibers which are longer than their diameter, with allowance for some fiber aggregates.

"Substantially dry" means a moisture content of about 20 weight percent or less and sufficiently dry to prevent adhesion of the resulting fibers and fines during fiberization. Preferably the secondary fiber source is air dry, meaning that the moisture content of the secondary fiber source is in equilibrium with the atmospheric conditions to which it is exposed. Typically, secondary fiber sources contain from about 3 to about 9 weight percent moisture, which is about the range for air dry paper. It is therefore preferred that no additional water be present or added to the secondary fiber source to be fiberized.

Figure 1 is a perspective view of a suitable fiberizer for use in the method of this invention with the front lid opened to expose the impeller blades and the serrated working surface.

Figure 2 is a cut-away perspective view of the opened fiberizer with the impeller removed to expose the orifice through which the processed fibers are withdrawn from the working chamber.

Figure 3 is a side elevation of the fiberizer partially in section illustrating its operation.

Figure 4 is a data plot obtained by image analysis, illustrating the particle size distribution of ink particles for two handsheets made from computer printout paper--one of the handsheets being made from wet-processed, non-deinked feed material, and the other handsheet being made from dry fiberized feed materials in accordance with this invention.

Directing attention first to Figure 1, a fiberizer used to fiberize secondary fiber sources for the purposes of this invention will be described in greater detail.

Figure 1 illustrates the internal working chamber of the fiberizer 1 primarily illustrating the position of the rotor blades. Such a fiberizer is illustrated in U.S. 3,069,103. The specific apparatus illustrated and used for purposes herein was a Pallmann Ref. 4 fiberizer. There is shown a serrated, grooved working surface 8 against which the feed material is abraded by the action of the moving rotor blades 9 which are driven by a

suitable drive means 2. Cooling water is provided to the fiberizer through inlet port 6 and exit port 7 for removing heat generated due to friction by the shearing of the fiber feedstock. Although not clearly shown in this Figure, there is a space between the serrated working surface and the blades in which cellulosic materials are buffeted about. The blade position relative to the working surface 8 is adjustable to add a
 5 degree of control over the extent of fiberization, which is also controlled by the rotor speed, the residence time, and nature of the working surface. The working surface 8 consists of six removable segments. These can be replaced by a greater or fewer number of segments having a different design or configuration with respect to the surface. This flexibility provides an infinite number of choices for altering and optimizing the fiberization. However, the configuration illustrated herein has worked very satisfactorily. More specifically,
 10 the grooves of each segment as shown are parallel to each other and are spaced apart by about 2 millimeters (mm), measured peak-to-peak. Each groove is about 1.5 mm deep. The radial width of each segment is about 10 centimeters (cm). These dimensions are given only for purposes of illustration and are not limiting, however. Also partially shown is the working surface on the inside of the hinged cover 10, which is substantially identical to the other working surface 8 already described. When the cover is closed,
 15 the two working surfaces provide an inner chamber in which the feed material is fiberized.

Figure 2 is a cut-away perspective of the fiberizer with the rotor removed to expose the orifice 11 through which the fiberized material passes before exiting through the exit port 4. The size of the orifice is a variable which controls the degree of fiberization by increasing or decreasing the air flow rate and hence the residence time within the fiberizer. The orifice is contained within a removal plate 12 for convenient
 20 changing of the orifice size. An orifice diameter of 160 mm has been found to be suitable in conjunction with an air flow rate of about 10 cubic meters per minute. Also shown in Figure 2 are the impeller blades 13 of the fan which provide the flow of air through the fiberizer.

Figure 3 is a cross-sectional, cut-away view of the fiberizer schematically illustrating its operation. The arrows indicate the direction of flow of air and fibers. More specifically, secondary fiber source 15 is introduced into the feed inlet 3 where it is contacted by the rotating blades 9. The air flow directs the
 25 secondary fiber source between the rotor blades and the working surface 9 such that the secondary fiber source is comminuted into smaller and smaller particles, eventually being reduced or fiberized to substantially discrete fibers and fines. The centrifugal forces created by the rotor blades tend to force the particles, preferentially the larger particles, to the apex 16 between the angled working surfaces. These forces tend to
 30 keep the larger particles from escaping before they have been completely fiberized. Upon substantially complete fiberization, the comminuted solid materials are carried through the orifice 11 of the removal plate 12. The fan impellers 13 then force the airborne fibers out through the exit port 4. The fiberized material consisting essentially of substantially discrete fibers and fines is collected and can be directly used as a
 35 feedstock for preparing newsprint furnish in the conventional manner.

Figure 4 will be described below in connection with the Examples.

EXAMPLES

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In order to illustrate the various aspects of this invention, a number of newsprint handsheets was prepared using different newsprint furnishes, including furnishes containing substantially discrete fibers and ink-containing fines produced by substantially dry fiberization of secondary fiber sources as described above. The resulting newsprint handsheets were then tested for brightness (GE Brightness) which repre-
 45 sents a measure of the quantity and size of ink specks in the handsheet. Higher numbers represent greater reflectance and greater brightness. Sample No. 1 was made from a standard newsprint furnish containing (on a dry basis) 32 parts semi-bleached kraft fibers, 68 parts groundwood fiber, and 7 parts clay filler (Zeolex). Sample Nos. 2, 3, and 4 were made from a furnish containing varying amounts of dry fiberized secondary fiber source material (individual fibers and fines) in accordance with this invention. Sample No. 5
 50 was made from a furnish containing an amount of secondary fiber source which was wet fiberized by mixing with water at a 3% consistency. The secondary fiber source portion of the furnishes for Sample Nos. 2-5 consisted of 1/3 manifold white ledger, 1/3 white ledger, and 1/3 non-impact printed computer printout paper. In each case the furnish components were separately slurried and blended together to a final consistency of 0.06 weight percent solids before being used to form the handsheets. Handsheet formation
 55 was performed in a conventional manner.

The GE Brightness Index was determined for each handsheet by measuring the percent reflectance of blue light relative to a standard white surface. The particular instrument used was a "Brightmeter Model S4 Brightness/Color Tester" manufactured by Technidyne Corp. A total of six different measurements was

taken for each sample and the average of the six measurements was calculated as the GE Brightness Index.

The results are summarized below in Table I (the furnish compositions are in dry parts by weight):

TABLE I
Newsprint Handsheet Results

Sample	Semi-Bleached Kraft	Ground-wood	Clay Filler	Dry Fiberized Secondary Source	Wet Fiberized Secondary Fiber Source	GE Brightness Index
1	32	68	7	0	0	64.3
2	5	55	7	40	0	66.9
3	10	60	7	30	0	66.9
4	15	65	7	20	0	65.9
5	5	55	7	0	40	59

These results show that the brightness in the newsprint sheets produced in accordance with this invention is substantially better (higher) than the brightness in the sample made with the same secondary fiber source furnish component, but which was wet fiberized instead of being dry fiberized. (Sample Nos. 2, 3, and 4 vs. 5). In addition, the brightness values for the samples of this invention are actually higher than those of the control newsprint furnish, apparently due to the higher fiber quality of the secondary fiber source.

In order to further illustrate the improvement obtained by using dry-fiberized secondary fiber sources, handsheets were prepared using 100% non-impact printed computer printout (CPO) paper as the sole fiber source. Sample #1 was prepared by wet fiberizing (slurrying) the CPO paper in water to produce the furnish. Sample #2 was prepared by dry fiberizing the CPO prior to slurrying with water to form the furnish. In both cases the ink-containing fines resulting from the fiberization were not removed.

After the handsheets were formed and dried, both samples were subjected to image analysis to quantify the nature of the ink specks appearing on the surfaces of the two samples. The image analyzer measured the area of each speck larger than 5 μm and, based on the area, calculated an equivalent circular diameter for each speck. The particular image analyzer used was a Quantimet 720 manufactured by Cambridge. The machine was coupled with a 50 mm EL-Nikon lens having a 70 mm extension tube set at f4. It was set up with a fluorescent ring sample illumination source and detected reflectance measuring less than 40 on a scale of 0-64, where 0 is black (no reflectance) and 64 is white (total reflectance). The machine measured 20 fields per sample with a field size of 7.5 mm x 5.75 mm.

The results of the image analysis of Samples #1 and #2 are set forth in TABLE II and in Figure 4. Figure 4 is a plot of the speck size distribution for each sample, showing the reduction in detectable ink specks present in the handsheet prepared in accordance with this invention. As can be seen from the plot, the sample of this invention (Sample #2) contains ink particles of a size substantially in the range of 70 μm or less. TABLE II further illustrates the improvement in terms of the average speck size, the total speck area, the number of specks detected, and the brightness of each sample.

TABLE II
Image Analysis

Sample	Speck Area (%)	Mean Equivalent Circular Diameter (μm)	Total Speck Count	GE Brightness
1	0.967	51.7	2218	67.4
2	0.094	38.1	552	72.0

As illustrated by Table II and Figure 4, the dry fiberization of the secondary fiber source results in a large amount of very fine ink specks which are not detectable and therefore do not significantly adversely affect the quality of the paper made therefrom. In addition, those ink particles which are detectable are smaller and fewer than those produced by wet fiberization. Therefore the dry fiberization provides a means
 5 for utilizing secondary fiber sources without the need for deinking.

Those skilled in the art of newsprint manufacture will appreciate that the foregoing examples are given for purposes of illustration only and are not to be construed as limiting the scope of this invention.

10 Claims

1. A newsprint furnish comprising substantially discrete fibers and ink-containing fines produced by substantially dry mechanical fiberization of a secondary fiber source.

2. The furnish of Claim 1 containing at least 20 dry weight percent of the discrete fibers and ink-
 15 containing fines produced by substantially dry mechanical fiberization of a secondary fiber source.

3. The furnish of Claim 1 or 2 wherein the secondary fiber source is selected from the group consisting of non-impact printed papers, computer printout paper, white ledger paper, and manifold white ledger paper.

4. A newsprint paper made from the furnish of one of the preceding Claims.

20 5. The newsprint paper of Claim 4 wherein the size of the ink particles of the ink-containing fines is substantially within the range of about 70 μm or less.

6. The newsprint paper of Claim 4 or 5 wherein the size of the ink particles is less than about 100 μm .

7. The newsprint of Claim 4 or 5 wherein the size of the ink particles is less than about 150 μm .

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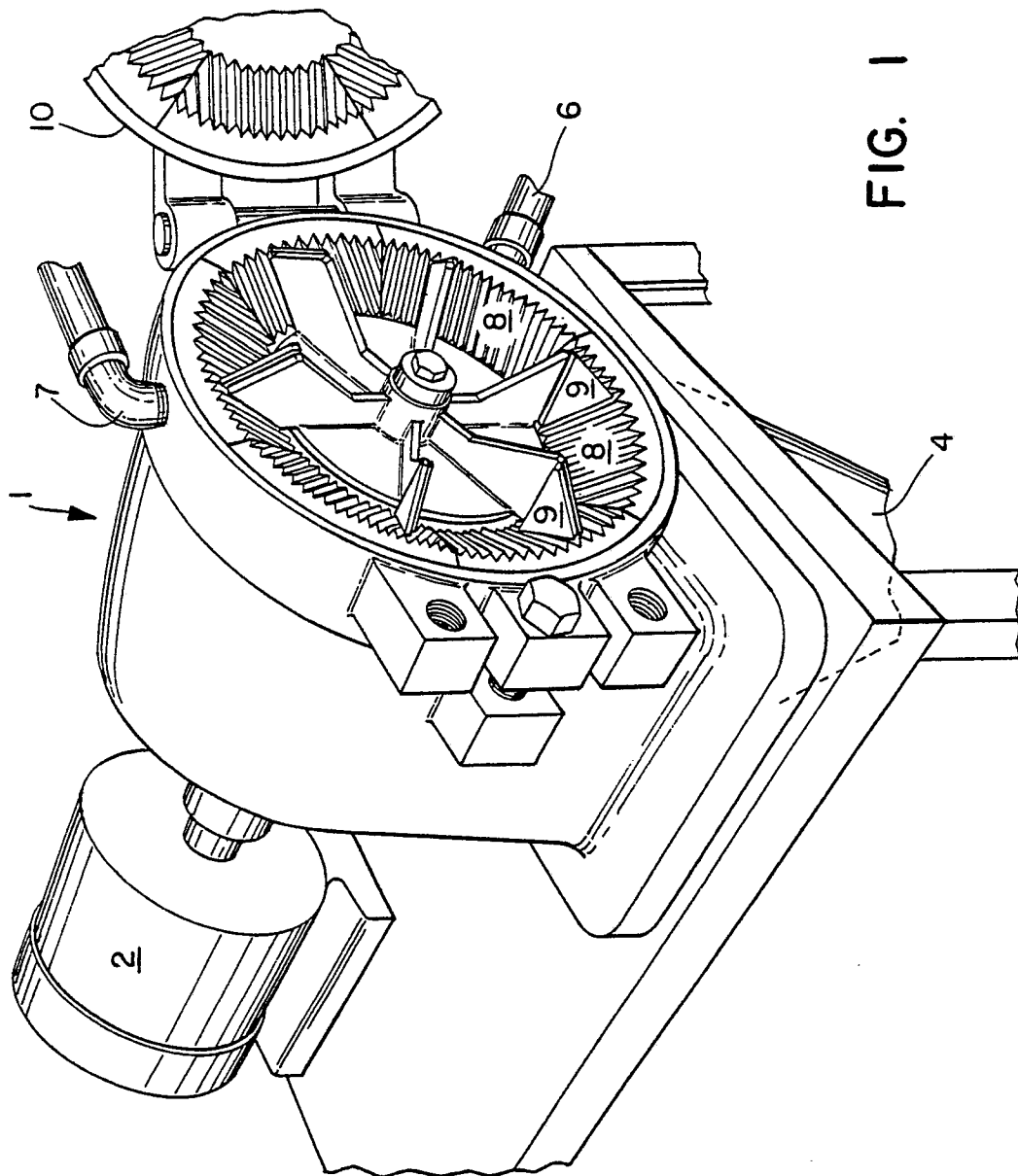


FIG. 1

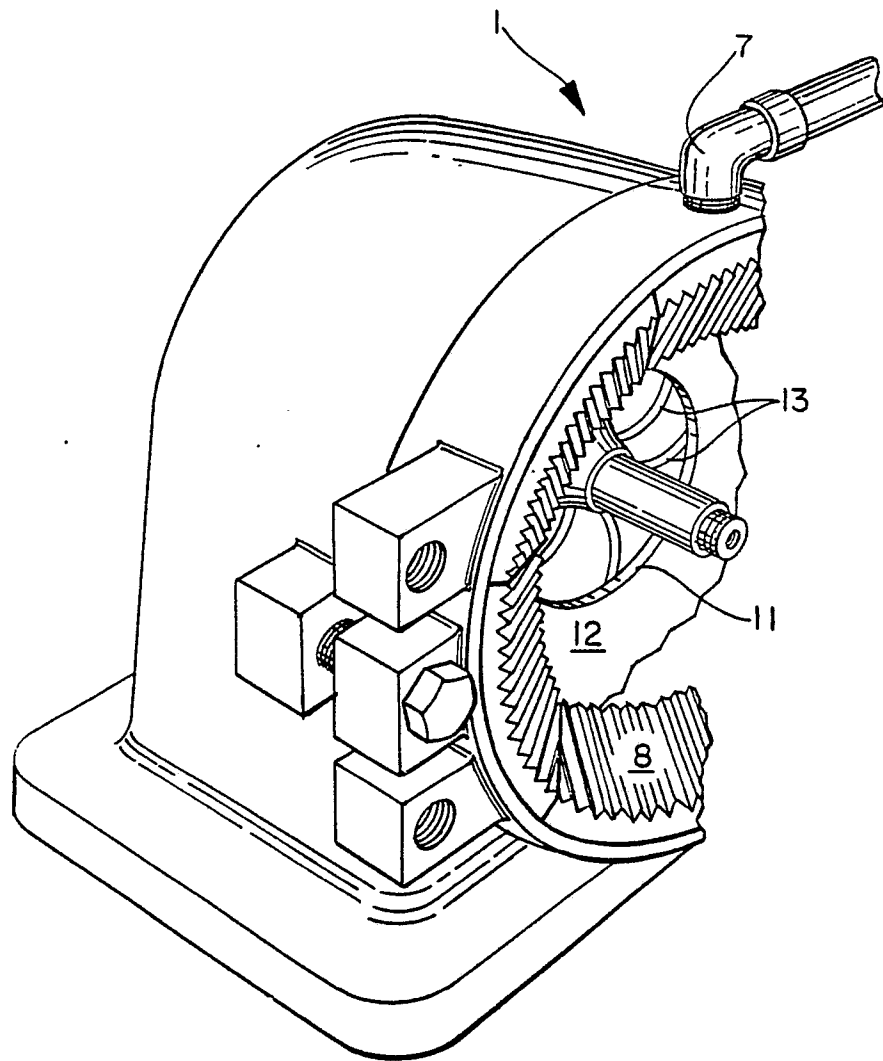


FIG. 2

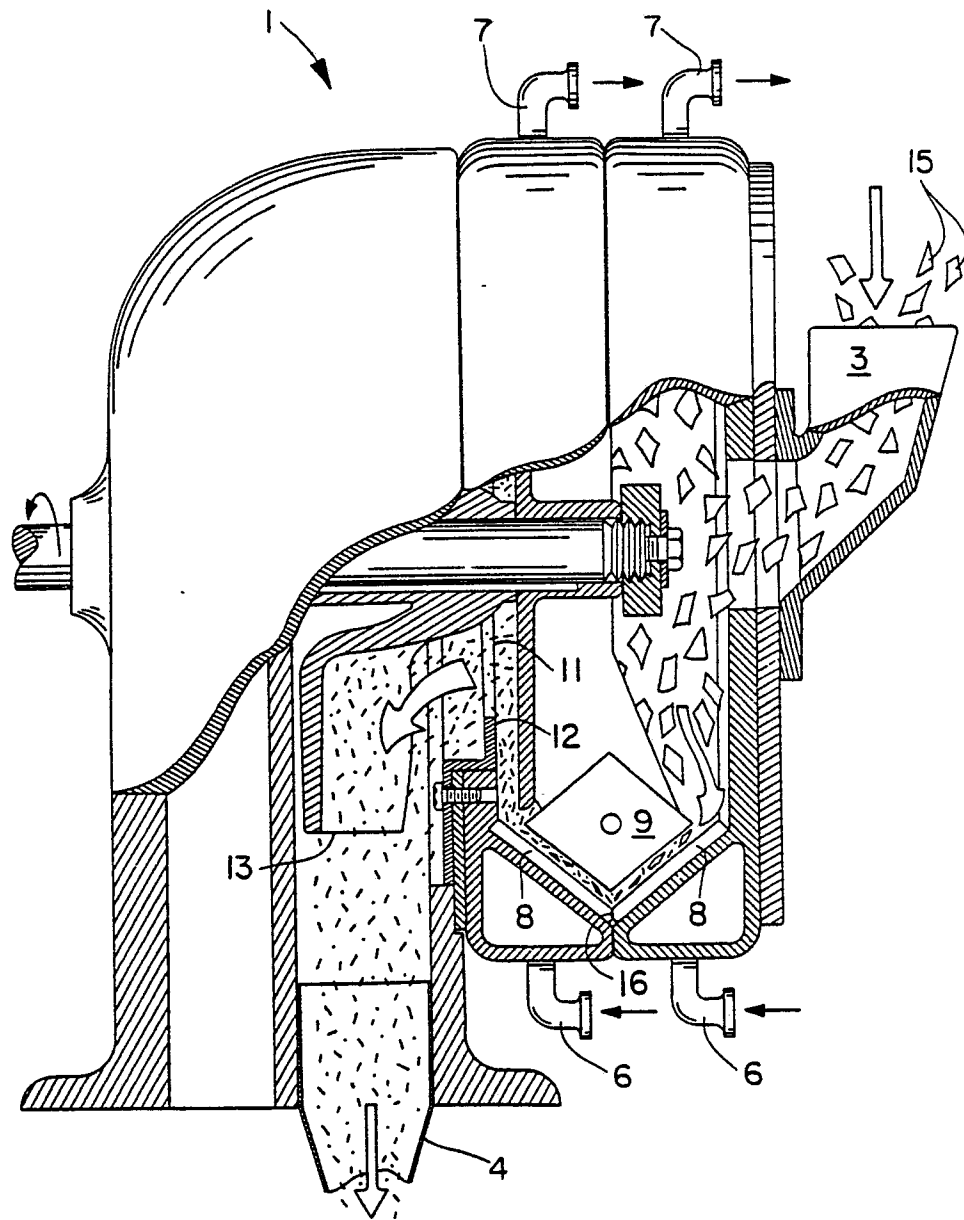


FIG. 3

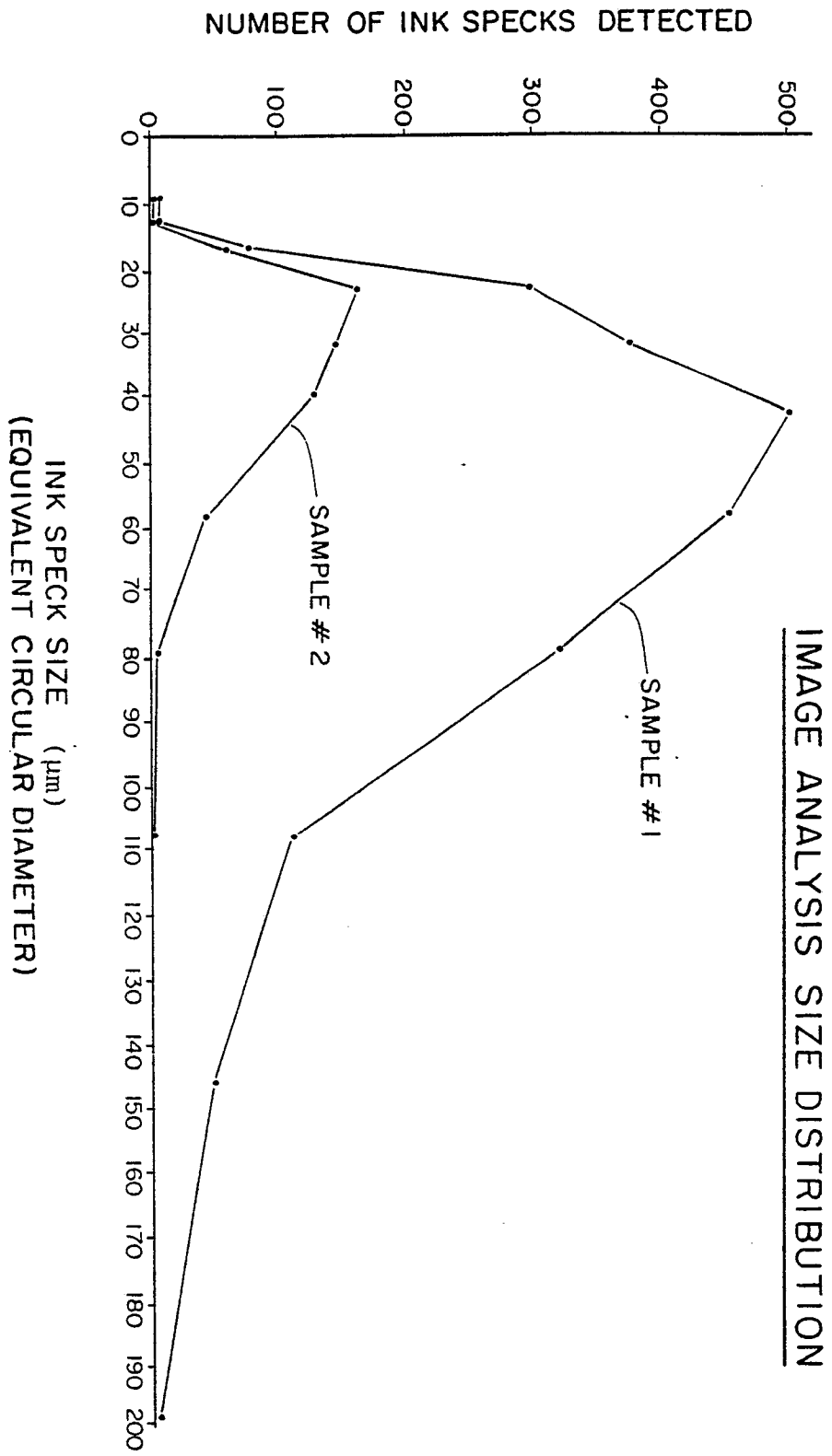


FIG. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X,Y	DE-B-1 097 802 (CONDEX-WERK H.A. MERGES KG) * Column 1, line 41 - column 2, line 48 * ----	1,2,4	D 21 H 5/14
Y	US-A-4 668 339 (B.R. TERRY) * Figure 7; claims 12,17,18; column 7, paragraph 2; examples * ----	1-4	
Y	GB-A-1 429 626 (WATFORD ENGINEERING) * Page 1, lines 10-55; page 2, lines 48-58 * ----	1	
Y	GB-A- 689 278 (DEFIBRATOR) * Figure 3; page 1, line 49 - page 2, line 42; page 2, line 113 - page 3, line 49 * ----	1,2,4-7	
Y	US-A-4 312 701 (R. CAMPBELL) * Abstract * ----	1,2,4-7	
Y	US-A-3 057 769 (N.H. SANDBERG) * Figures 2-4; column 2, line 42 - column 3, line 40; column 4, line 64 - column 5, line 17 * ----	1,2,4-7	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	US-A-2 910 398 (L.G. DURANT et al.) * Column 1, line 15 - column 2, line 32 * ----	1,2,4-7	D 21 B D 21 C D 21 H
Y	FR-A-2 417 580 (CENTRE TECHNIQUE DE L'INDUSTRIE DES PAPIERS, CARTONS ET CELLULOSES) * Figure 1; claims 1,10,11; examples 1,2 * ----- -/-	1-7	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30-06-1988	Examiner NESTBY K.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
Y	ABSTRACT BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, vol. 53, no. 6, December 1982, page 679, abstract no. 6227, Appleton, Wisconsin, US; V.A. GORBUSHIN et al.: "Waste paper in the composition of sanitary papers", & BUMAZH. PROM., no. 6, 14-15, June 1982 * Lines 7-14 of the abstract * ---	1,2,4	
A	FR-A-2 397 485 (A. BUJAK) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30-06-1988	Examiner NESTBY K.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			