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(54) **Folder for folding paper sheets**

(57) A folder for folding a sheet or a set of collated sheets having a pair of folding cylinders (1, 2; 51, 52) with a folding nip (3; 53) for pressing a fold (4) in a curved portion (5; 55) of the sheet or set of sheets (6; 56) passing through the folding nip (3; 53), a sheet support structure (7; 57) extending along a first side of the folding cylinders (1, 2; 51, 52) and the folding nip (3; 53) and two circulatory pressing members (9, 13; 59, 63) which are, when in an operating condition for folding, in contact with the cir-

cumference of a first folding cylinder (1, 51) and a second folding cylinder (2, 52) respectively, for urging the sheet or the set of sheets (6; 56) towards the folding nip (3; 53).

The sheet support structure (7; 57) constitutes a clamping area (16; 66) for clamping a set of sheets at least in a position spaced from the folding cylinders, thus allowing a sheets of different sizes to be folded as a single set.

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Description

DETAILED DESCRIPTION

FIELD AND BACKGROUND OF THE INVENTION

[0001] The invention relates to a folder according to the introductory portion of claim 1.

[0002] Such a folder is known from United States Patent 4,643,705. In this folder, a portion of a sheet is bent and fed into a nip between folding cylinders where a fold is formed in the sheet. When a set of sheets is to be folded, the sheets need to be of such sizes that at least the outer sheets are simultaneously engaged by the folding cylinders while a portion of the sheet is bent and the bent portion is passed into the folding nip and folded. This requirement limits the versatility of the folder, because it is not possible to process sets of sheets of which one or more outer sheets are too small to be engaged by the folding cylinders at the start of the folding process.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a folder which is suitable for reliably folding sets of sheets having widely differing lengths. According to the invention, this object is achieved by providing a folder according to claim 1.

[0004] Because, in a folder according to the invention, the sheet support structure further constitutes at least one clamping area for clamping a set of sheets at least in a position spaced from the folding cylinders, a set of sheets to be folded is not only held together at the folding cylinders, but also in a position spaced from the folding cylinders. This ensures that, during folding, also sheets which are too short to extend to the folding cylinders are reliably entrained towards and through the folding nip by the sheet or sheets of greater lengths.

[0005] Particular embodiments of the invention are set forth in the dependent claims.

[0006] Further objects, features, effects and details of the invention are described below with reference to examples of folders according to the invention.

BRIEF DESCRIPTION OF THE DRAWING

[0007]

Fig. 1 is a schematic side view of an embodiment of a folder according to the invention with a set of sheets on the sheet support surface;

Fig. 2 is a schematic side view of the folder shown in Fig. 1 with the set of sheets clamped in the clamping area;

Fig. 3 is a schematic side view of the folder shown in Figs. 1 and 2 with the set of sheets passing through a folding nip between folding cylinders; and

Fig. 4 is a schematic side view of another embodiment of a folder according to the invention.

[0008] In Figs. 1, 2 and 3, a folder is shown equipped with a pair of folding cylinders 1, 2, a sheet support structure 7, a first circulatable pressing member in the form of a roller 9 with a circumferential surface 10 and a second circulatable pressing member in the form of a roller 13 with a circumferential surface 14. The folding cylinders 1, 2, which are mutually coupled via interengaging gear wheels 27, 28 coaxial with the folding cylinders 1, 2 and coupled to a drive roller 29 via a drive belt 30. The folding cylinders 1, 2 define a folding nip 3 for pressing a fold 4 in a bent portion 5 of a sheet or set of sheets 6 passing through the folding nip 3 in a transport direction 18, while the folding cylinders 1, 2 are rotating in the transport direction. The sheet support structure 7 for supporting the sheet or the set of sheets 6 along a sheet plane 8 extends along a first side of the folding cylinders 1, 2 and the folding nip 3. In an operating condition just before, during and after folding (see Figs. 2 and 3), the circumferential surfaces 10 of the pressing rollers 9, 13 are in contact with circumferences 11 and, respectively 12 of the folding cylinders 1, 2 for urging the set of sheets 6 in circumferential sense along the respective folding cylinders 1, 2 towards the folding nip 3. Furthermore, the first and second pressing rollers 9, 13 are located on the first side of the folding cylinders 1, 2 and the folding nip 3 where the sheets 6 are located before folding.

[0009] The sheet support structure 7 is constituted by a third circulatable pressing member in the form of a third pressing roller 15, a fourth circulatable pressing member in the form of a fourth pressing roller 17 opposite the third pressing roller, support plates 19, 20, 21, a fifth circulatable pressing member in the form of a fifth pressing roller 22, a sixth circulatable pressing member in the form of a sixth pressing roller 23 opposite and an abutment 24 against which a set of sheets 6 can be gathered and aligned.

[0010] A circumferential surface of the third pressing roller 15 constitutes a clamping surface of a clamping area 16. The clamping area 16 is formed between the third and fourth pressing rollers 15, 17 for clamping a sheet or set of sheets 6 in a position spaced from the folding cylinders 1, 2. A further clamping area 39, spaced from the folding cylinders 1, 2 is formed between the fifth pressing roller 22 and the sixth pressing roller 23.

[0011] The first and second pressing rollers 9, 13 opposite the folding cylinders 1, 2, the fourth and sixth pressing rollers 17, 23 opposite the third and fifth pressing rollers 15, 22 and a folding knife 24 are carried by a pressing frame 25 which is movable between a retracted position (Fig. 1) and a pressing position (Figs. 2 and 3). When the pressing frame 25 is in the retracted position, a clearance is left between on the one hand the folding cylinders 1, 2 and the third and fifth pressing rollers 15, 22 and, on the other hand, the first, second, fourth and sixth pressing rollers 9, 13, 17, 23. In this clearance, a set of sheets 6 to be folded can be received and moved

until it reaches a position in which the sheets are aligned against the abutment 24. When the frame 25 is in the pressing position, the first, second, fourth and sixth pressing rollers 9, 13, 17, 23 are pressed towards, respectively, the folding cylinders 1, 2 and the third and fifth pressing rollers 15, 22.

[0012] A third folding roller 31 and the second folding roller 2 define a second folding nip 32. The third folding roller 31 and the second folding roller 2 are mutually coupled via the gear wheel 28 coaxial with the second folding cylinder 2 and a further gear wheel 33 coaxial with the third folding cylinder 31. A second folding knife 34 and a seventh pressing roller 35 are mounted to a second pressing frame 36, which is movable between a retracted position (Figs. 1 and 2) and a pressing position (Fig. 3). When the pressing frame 36 is in the retracted position, a clearance is left between, on one side the seventh pressing roller 35 and the folding knife 34 and, on the other side, the second folding cylinder 2 and the third folding cylinder 31. When the pressing frame 36 is moved to the pressing position, the seventh pressing roller 35 is pressed against the third folding cylinder 31 and the second folding knife 34 is moved towards the second folding nip for bending another portion of the sheets 6 extending along the second folding cylinder 2 and the third folding cylinder 31.

[0013] After a set of collated sheets 6 has been transported to a position supported by the sheet support structure 7 (see Fig. 1), the pressing frame is displaced from the retracted position into the pressing position. Thereby, the set of sheets 6 is clamped between the folding cylinders 1, 2 and the first and second pressing rollers 9, 13. Moreover, the sheets are clamped in the clamping area 16 between the third and fourth pressing rollers 15, 17. The sheets are also clamped between the fifth and sixth pressing rollers 22, 23.

[0014] A portion 26 of the sheets 6 that extends over the folding nip 3 is bent by the folding knife 24 pressing that bent portion 26 of the sheets 6 in the transport direction 18 towards the folding nip 3 and is subsequently buckled by simultaneously rotating the folding cylinders 1, 2 such that surface portions of the folding rollers 1, 2 move in the transport direction 18. This causes sheet portions on opposite sides of the bent portion 5 as well as the first and second pressing members 9, 13 to be entrained by the folding cylinders 1, 2 such that the curved portion 5 is bent further and urged towards and into the folding nip 3 between the folding cylinders 1, 2. This causes the bent portion 5 to be bent further and when a pleat formed thereby passes in the transport direction 18 through the nip 3, a fold 4 is pressed in the bent portion 5 of the sheets 6 by the folding cylinders 1, 2.

[0015] After the fold 4 is pressed, the set of sheets 6 is transported through the folding nip 3 until a position extending along the second folding cylinder 2 and the third folding cylinder 31 is reached. Then, the pressing frame 36 is moved to the pressing position, so that the sheets 6 are clamped between the seventh pressing roll-

er 35 and the third folding cylinder 31 and the second folding knife 34 is moved towards the second folding nip 32 for bending another portion of the sheets 6 extending along the second folding cylinder 2 and the third folding cylinder 31. By further rotating the second and third folding cylinders 2, 31, first a pleat is formed from the second bent portion, which is then folded in the second folding nip 32. Thus, when the set of sheets 6 has passed the first pair of folding cylinders 1, 2, partially or completely, a second fold is made, such that the set of sheets 6 is folded in three panels.

[0016] A simple, low cost construction has been obtained, because the third pressing roller 15 is mounted freely rotatable such that it can be entrained by the sheet or set of sheets 6. Simplicity of construction is further enhanced, because also the fourth to seventh pressing rollers 17, 22, 23, 31 are mounted freely rotatable, to be entrained by the movement of the sheets 6 engaged by the driven folding cylinders 1, 2, 31.

[0017] In the example shown in Fig. 4, the sheet support structure 57 has first to fourth circulatable pressing members in the form of first to fourth conveyor belts 59, 63, 65, 72. The folder according to this example is further equipped with first and second folding cylinders 51, 52 defining a folding nip 53 for pressing a fold in a curved portion 55 of a sheet or set of sheets 56 passing through the folding nip 53 in a transport direction, while the folding cylinders 51, 52 are rotating in the transport direction. The sheet support structure 57 is arranged for supporting the sheet or the set of sheets 56 along a sheet plane 58 extending along a first side of the folding cylinders 51, 52 and the folding nip 53.

[0018] The first conveyor belt 59 has a circumferential surface 60 in contact with a circumference 61 of a first one of the folding cylinders 51 for urging the sheet or the set of sheets 56 in circumferential sense along the first folding cylinder 51 towards the folding nip 53. The second conveyor belt 63 has a circumferential surface 64 which is in contact with a circumference 62 of a second one of the folding cylinders 52 for urging the sheet or the set of sheets 56 in circumferential sense along the second folding cylinder 52 towards the folding nip 53.

[0019] The third conveyor belt 65 has a circumferential surface of which a section in contact with the second conveyor belt 63 constitutes a clamping surface of a clamping area 66. Thus, in this embodiment, the clamping area 66 spaced from the folding cylinders 51, 51 is formed between the second and third conveyor belts 63, 65 and, in the operating condition shown in Fig. 4, the set of sheets 56 is clamped in the clamping area 66 spaced from the folding cylinders 51, 52.

[0020] One of the folding cylinders 51 is mounted on a pivotable arm 87 so that the first folding cylinder 51 is displaceable to and fro in directions indicated by arrow 88 to be able to separate the circumferences 61, 62 of the folding cylinders 51, 52 temporarily from each other to allow the folding cylinders 51, 52 to rotate in the same sense of rotation while a sheet or set of sheets is trans-

ported along the plane 58 to a position supported by the sheet support structure 57 from where the sheet or set of sheets is to be folded. After a set of sheets 56 has been transported to the sheet support structure 57, the set of sheets 56 is not only clamped against the folding cylinders 51, 52, but also clamped in the clamping area 66 by the second and third conveyor belts 63, 65 and in a further clamping area 89 between the first and fourth conveyor belts 59, 72.

[0021] After the first folding cylinder 51 has been pivoted back towards the second folding cylinder 52, so that the folding nip 53 is again in operative state for folding, the bent portion 55 of the sheets 56 that extends over the folding nip 53 is bent further, which causes a pleat to be formed and to move into the folding nip 53 until a fold is formed therein in the folding nip 53. This movement is driven by simultaneous rotation in opposite directions of the first and second conveyor belts 59, 63 such that the curved portion 55 between portions of the sheets 56 oriented in different directions is bent further and urged into the folding nip 53. After the fold is pressed, the set of sheets 56 can be transported further past the folding cylinders 51, 52 for further processing.

[0022] While the invention has been illustrated and described in detail in the drawing and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

[0023] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

Claims

1. A folder for folding a sheet or a set of collated sheets, said folder comprising:

a pair of folding cylinders (1, 2; 51, 52) defining a folding nip (3; 53) between the folding cylinders (1, 2; 51, 52) for pressing a fold (4) in a curved portion (5; 55) of the sheet or set of sheets (6; 56) passing through the folding nip (3; 53) in a transport direction while the folding cylinders (1, 2; 51, 52) are rotating in the transport direction; a sheet support structure (7; 57) for supporting the sheet or the set of sheets (6; 56) along a sheet plane (8; 58) extending along a first side of the folding cylinders (1, 2; 51, 52) and the folding nip (3; 53);

a first circulatable pressing member (9; 59) having a circulatable circumferential surface (10; 60) which, in an operating condition for folding, is in contact with a circumference (11; 61) of a first one of said folding cylinders (1; 51) for urging the sheet or the set of sheets (6; 56) in circumferential sense along the first folding cylinder (1;

51) towards the folding nip (3; 53); and a second circulatable pressing member (13; 63) having a circulatable circumferential surface (14; 64) which, in an operating condition for folding, is in contact with a circumference (12; 62) of a second one of said folding cylinders (2; 52) for urging the sheet or the set of sheets (6; 56) in circumferential sense along the second folding cylinder (2; 52) towards the folding nip (3; 53);

wherein the first and second circulatable pressing members (9, 13; 59, 63) are located on said first side of the folding cylinders (1, 2; 51, 52) and the folding nip (3; 53);

characterized in that the sheet support structure (7; 57) further constitutes at least one clamping area (16; 56) for clamping a set of sheets at least in a position spaced from the folding cylinders (1, 2; 51, 52).

2. The folder of claim 1, further including a third circulatable pressing member (15; 65) of which a circumferential surface constitutes a clamping surface of the clamping area.
3. The folder of claim 2, further comprising a fourth circulatable pressing member (17), the clamping area being formed between said third and fourth circulatable pressing members (15, 17).
4. The folder of claim 2 or 3, wherein at least the third circulatable pressing member (15; 65) is freely rotatable to be entrained by the sheet or set of sheets (6; 56).

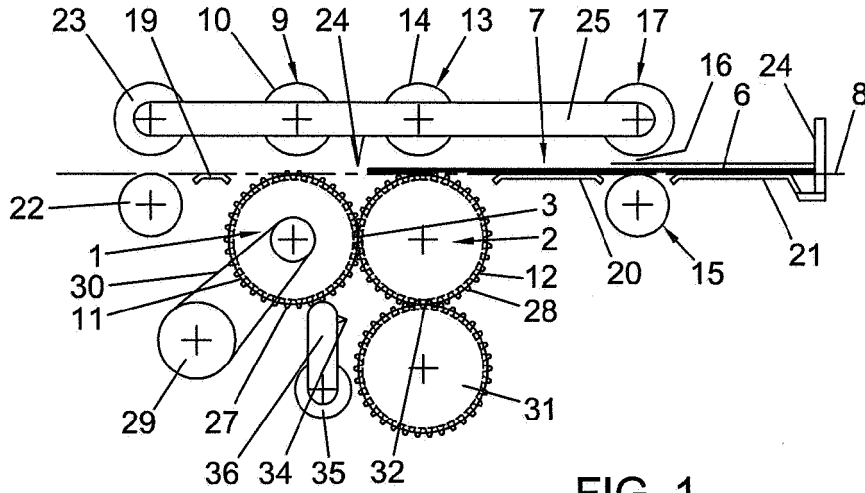


FIG. 1

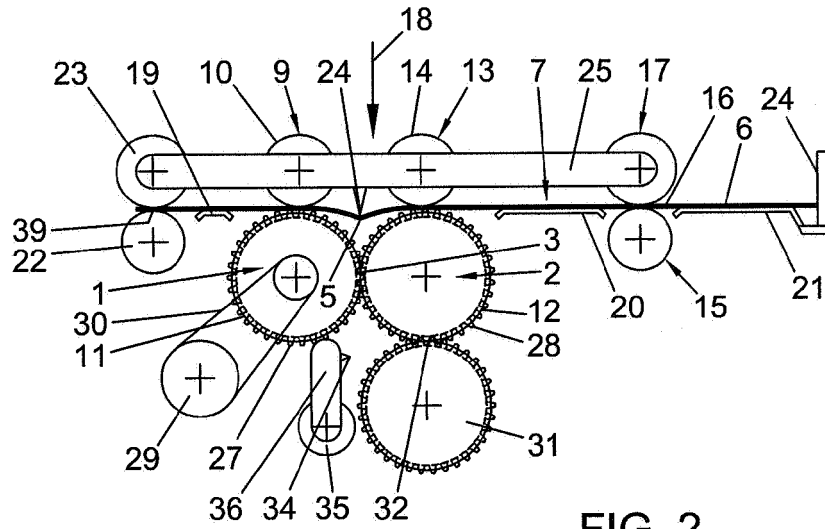


FIG. 2

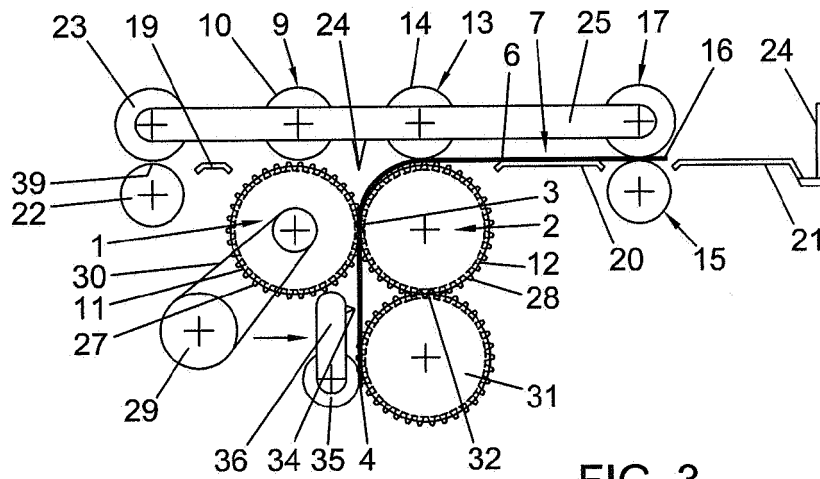


FIG. 3

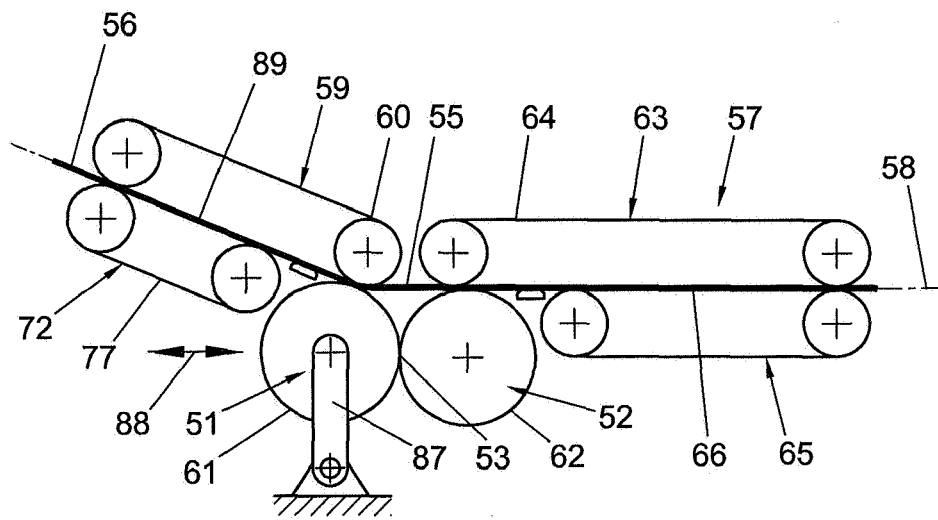


FIG. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 196 11 787 A1 (FRANCOTYP POSTALIA GMBH [DE]) 18 September 1997 (1997-09-18) * the whole document *	1-4	INV. B65H45/18 B65H45/14
X	US 6 309 336 B1 (MUESSIG KARL [DE] ET AL) 30 October 2001 (2001-10-30) * the whole document *	1-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		25 July 2008	Raven, Peter
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 15 2509

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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25-07-2008

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 19611787	A1	18-09-1997	NONE	

US 6309336	B1	30-10-2001	DE 19814917 A1	14-10-1999

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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