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(54) TOILET PAPER ROLL AND METHOD OF MANUFACTURING THE PAPER ROLL

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(30) **Foreign Application Priority Data**

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Feb. 15, 2000 (JP) 37301/2000
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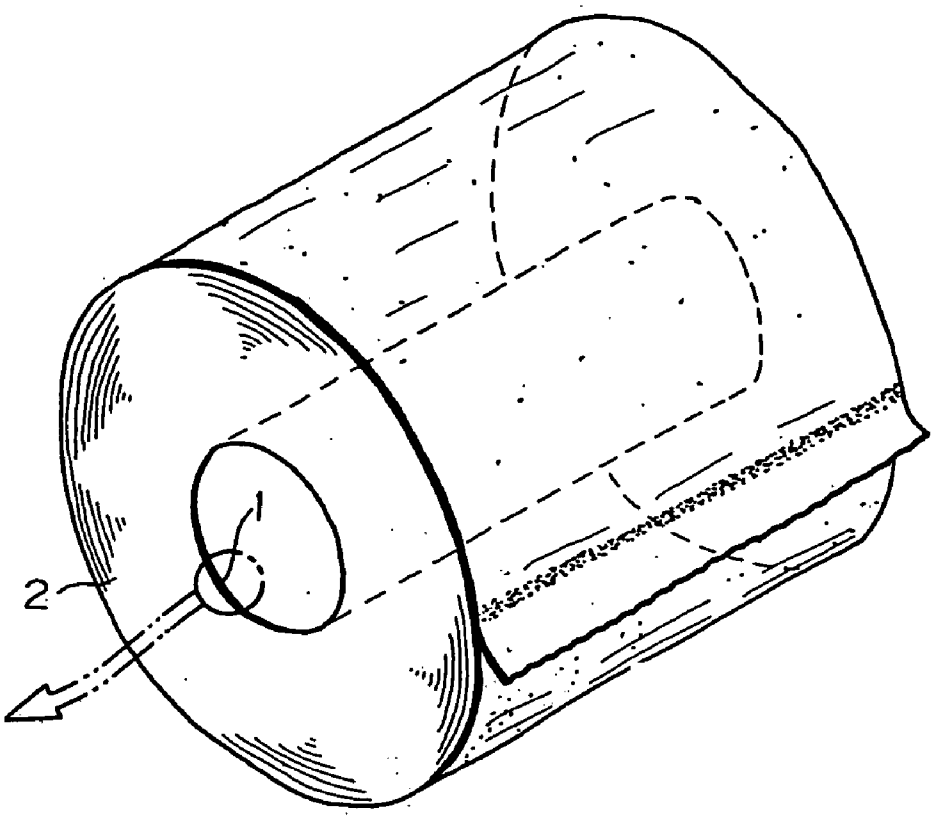
(52) **U.S. Cl.** **242/160.1**

(57) **ABSTRACT**

A toilet paper roll capable of remarkably reducing unwinding noise when used as a toilet paper roll, improving a refuse treatment measure by easily crushing and disposing off a thick core of the paper roll, reducing the production cost of the paper roll, flowing the thick core into a toilet and, when used, allowed to be recovered generally to a circular section form for practical use while the storage and transportation costs of the paper roll are reduced, comprising the thick core(**1**) made of thin paper of approx. 4 cm in outside diameter and toilet paper(**2**) generally softly wound on the thick core(**1**) from the first to the last, wherein the thick core(**1**) is formed flat as required, and the toilet paper(**2**) is also formed in a flat elliptic shape so as to follow up the flat thick core(**1**).



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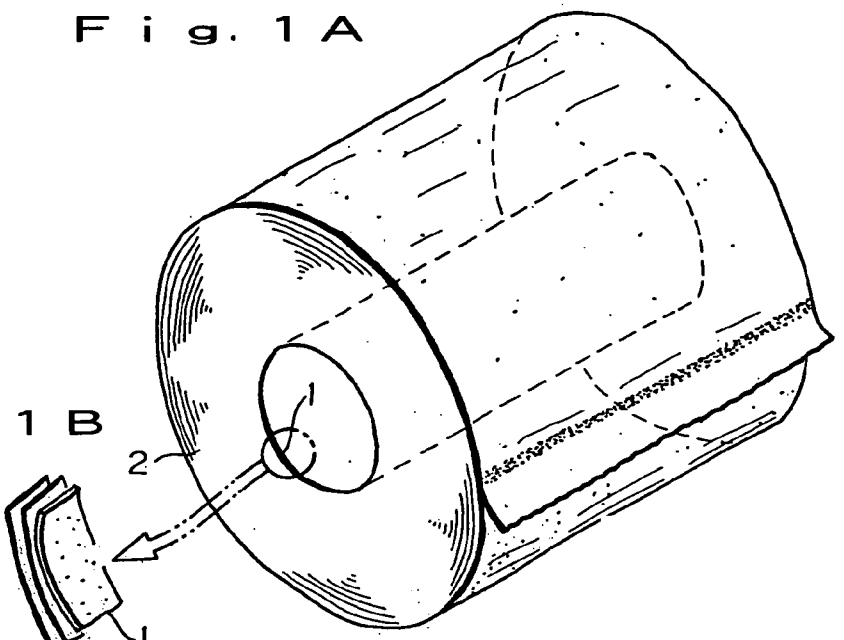
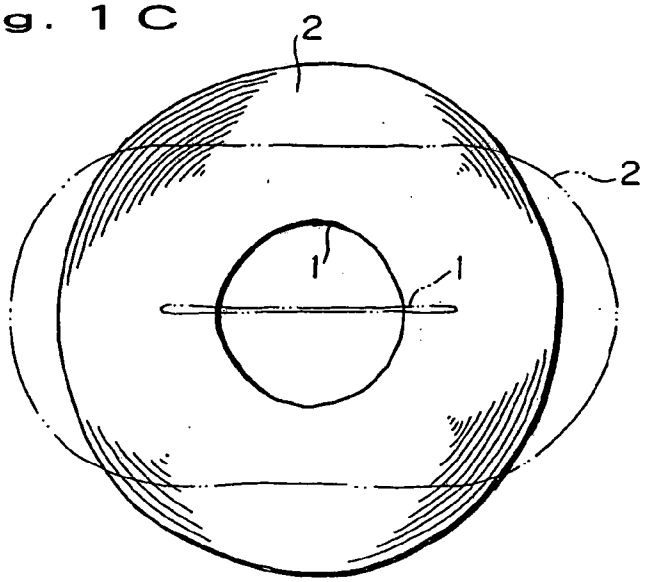


Fig. 1B

Fig. 1C



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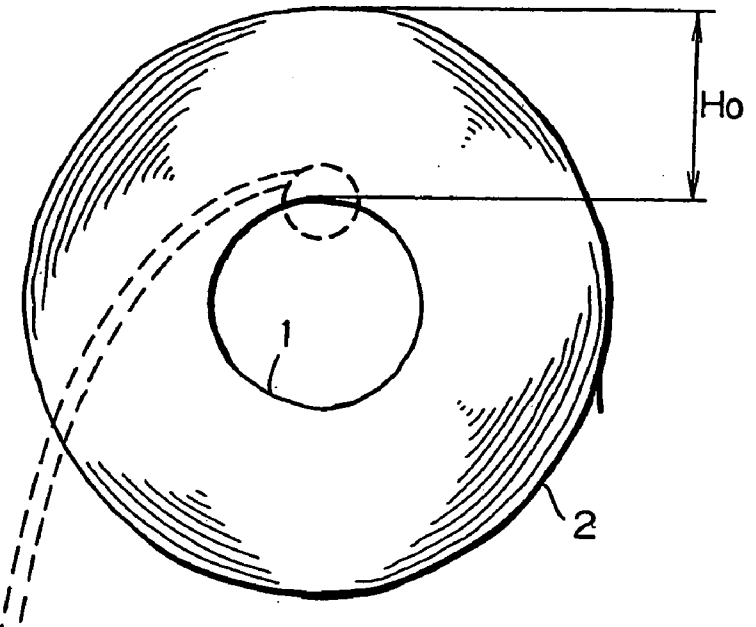

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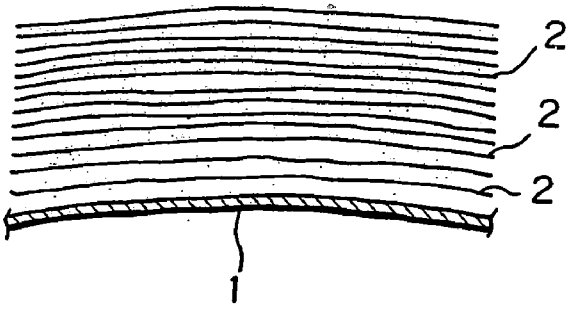

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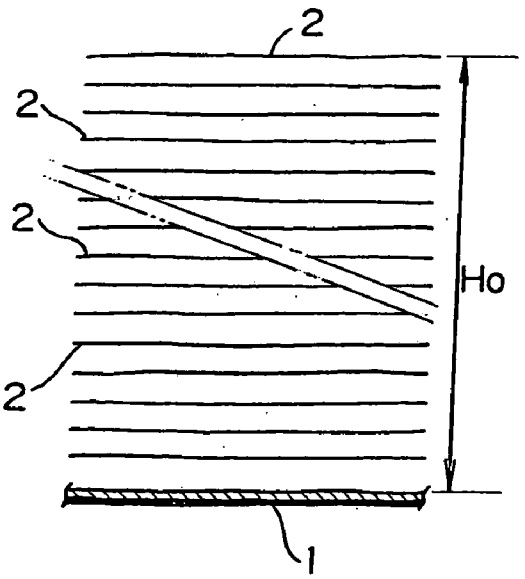

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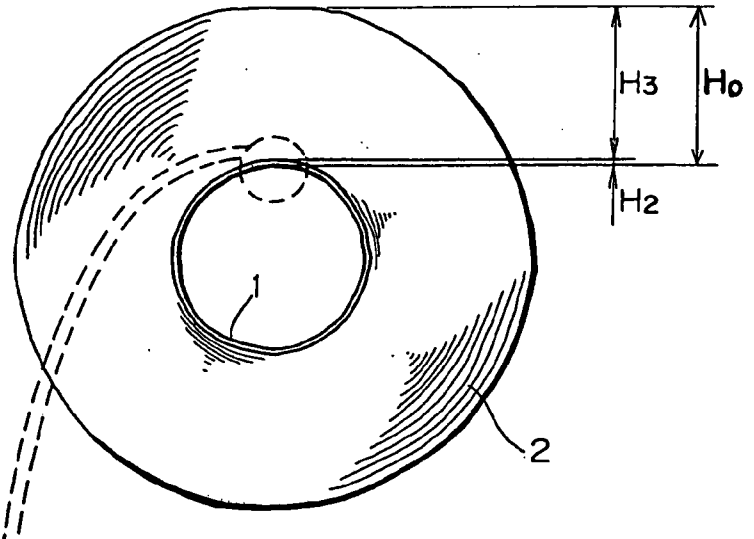

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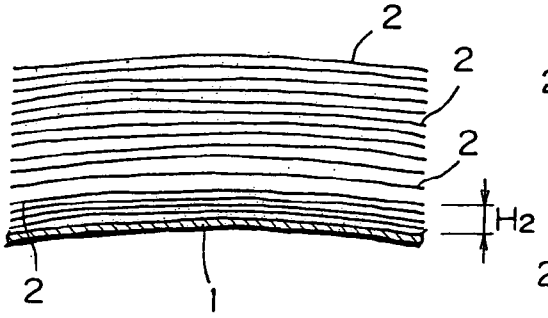

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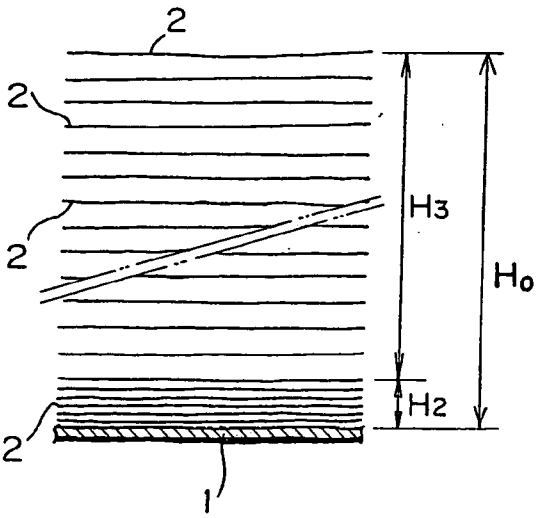

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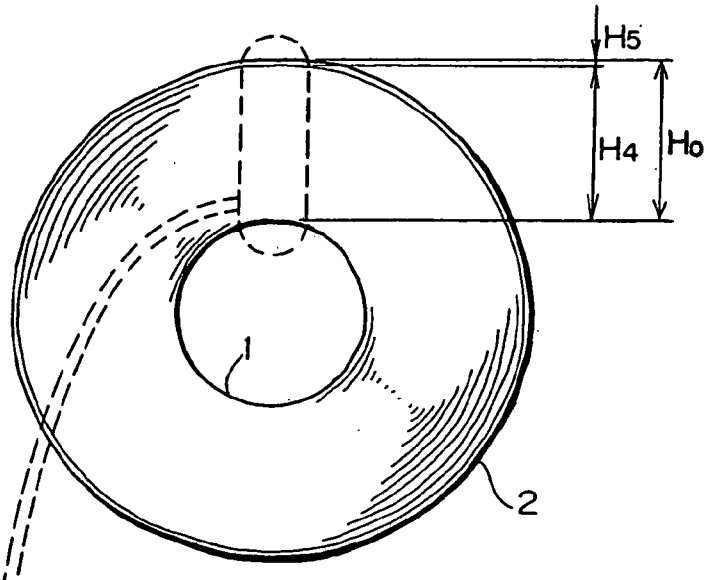

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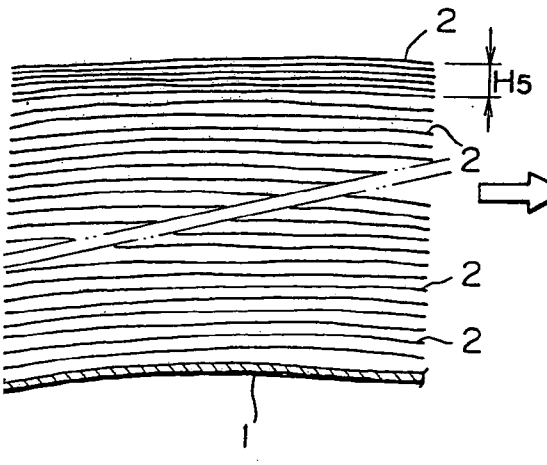

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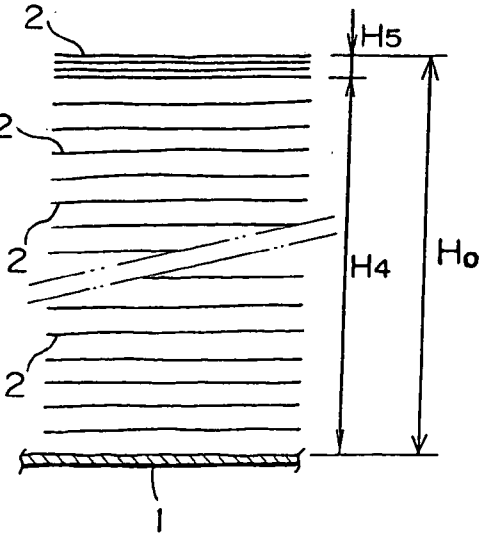

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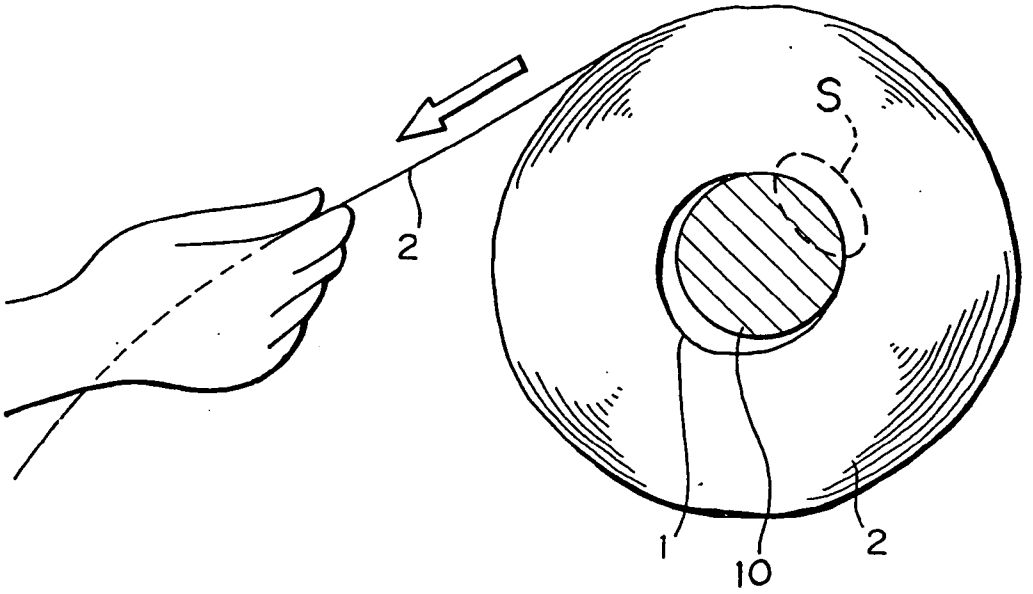

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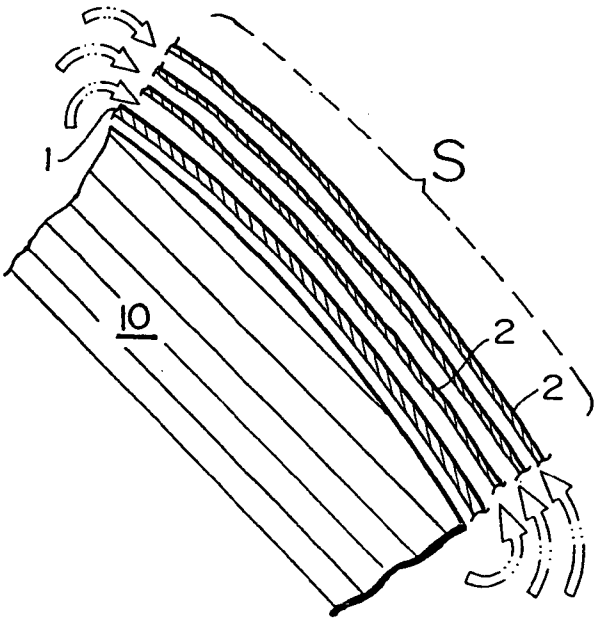

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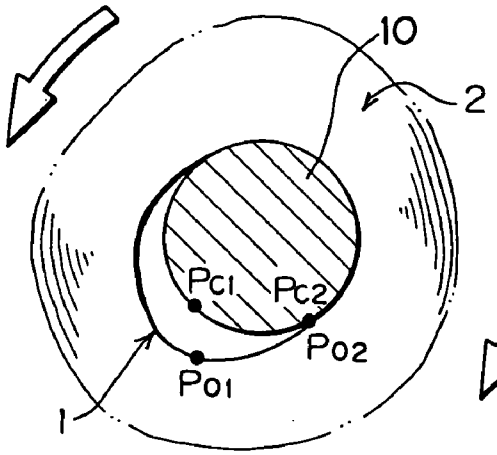

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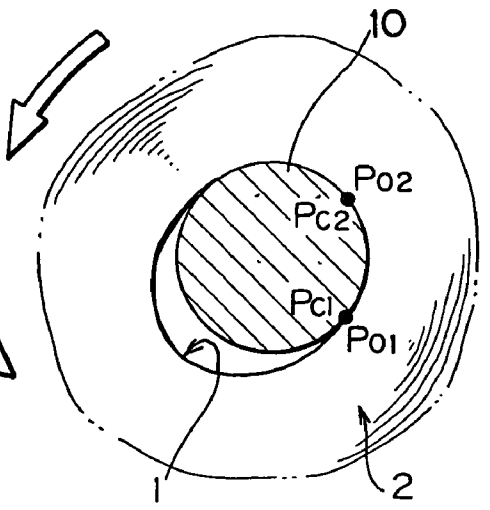

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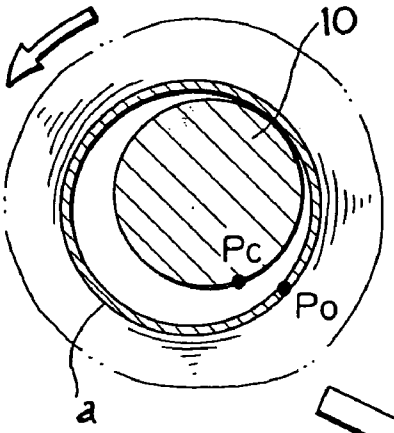

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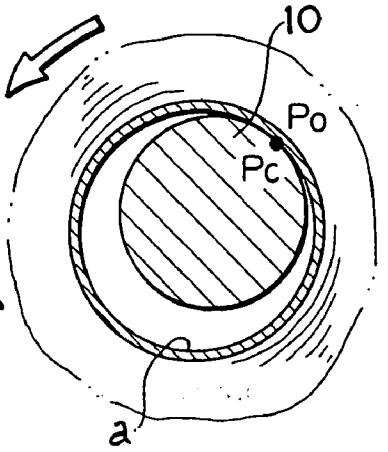

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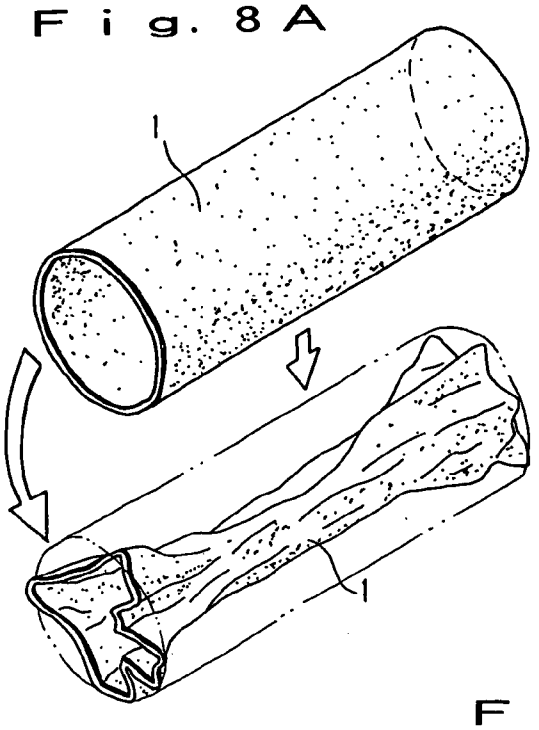

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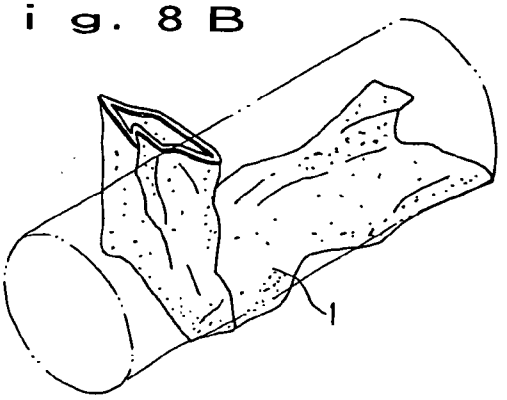

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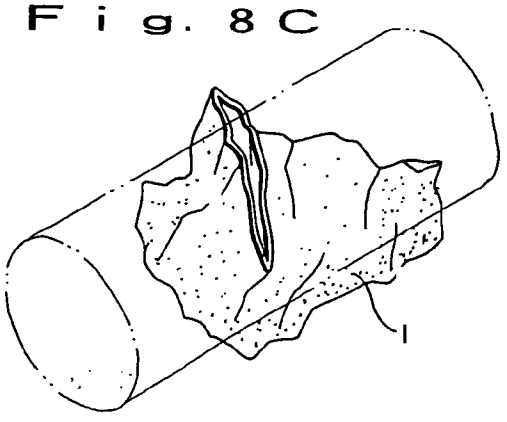

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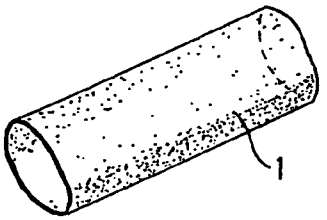

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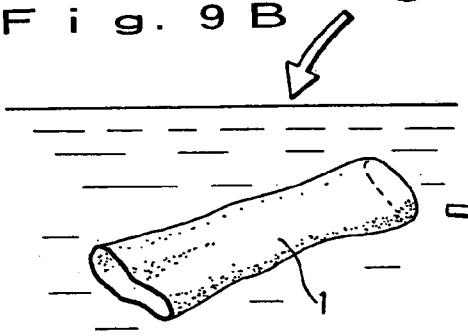

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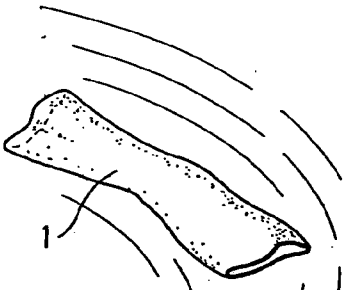

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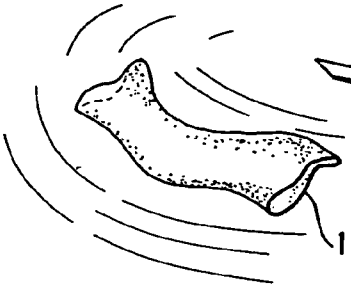

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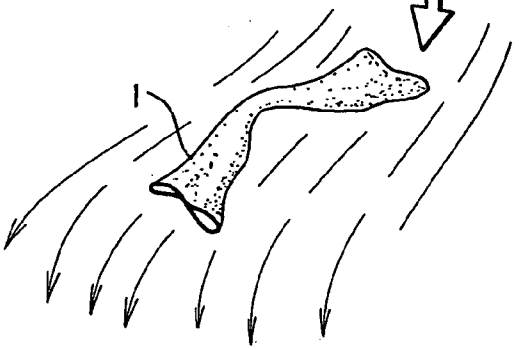

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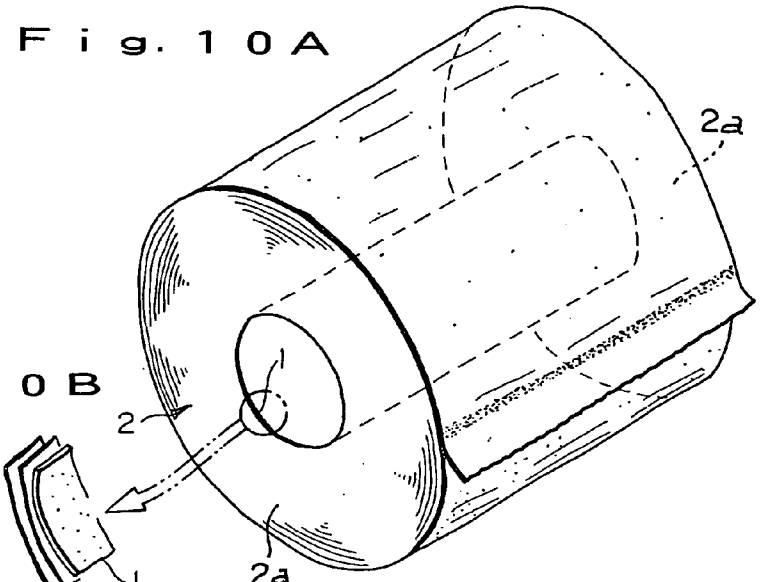
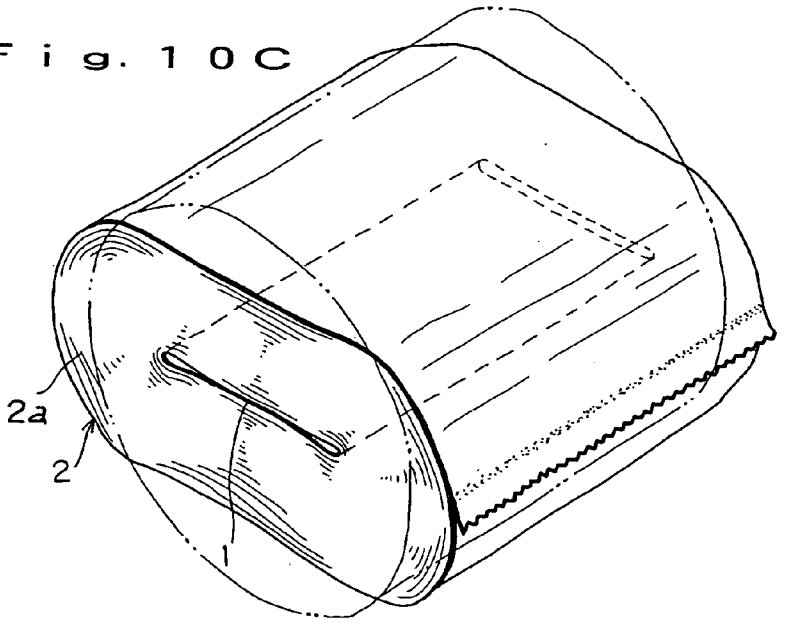


Fig. 10B

Fig. 10C



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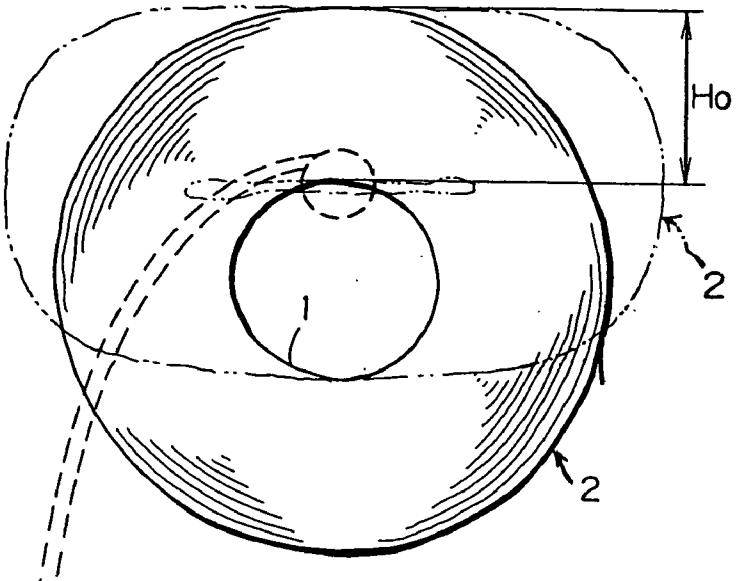

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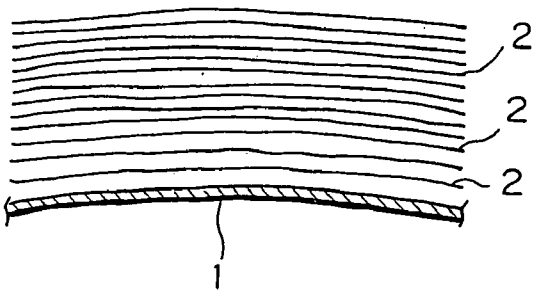

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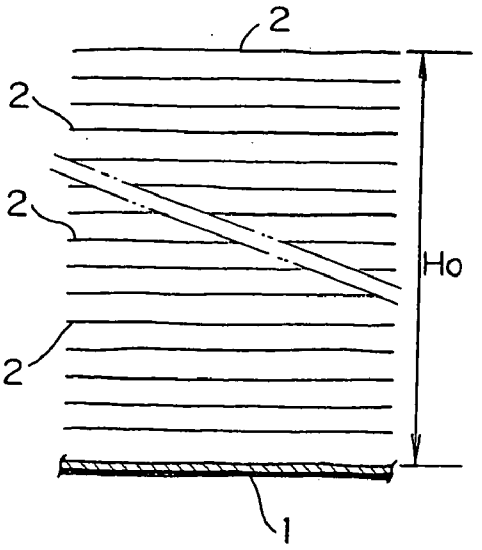

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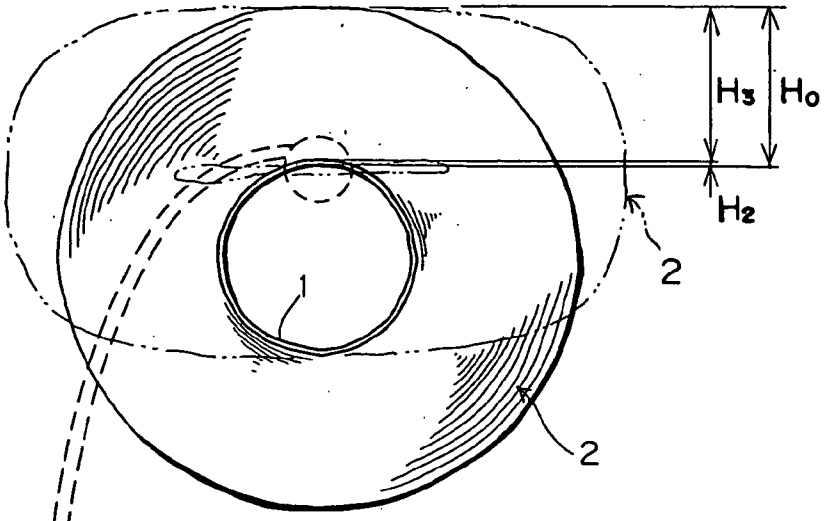
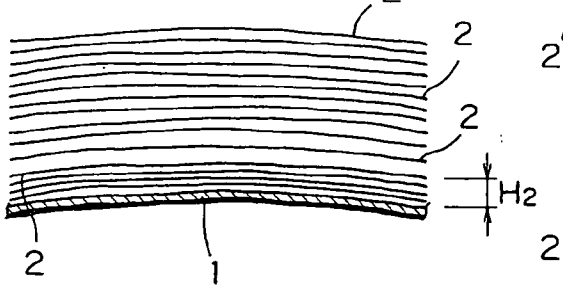


Fig. 12B



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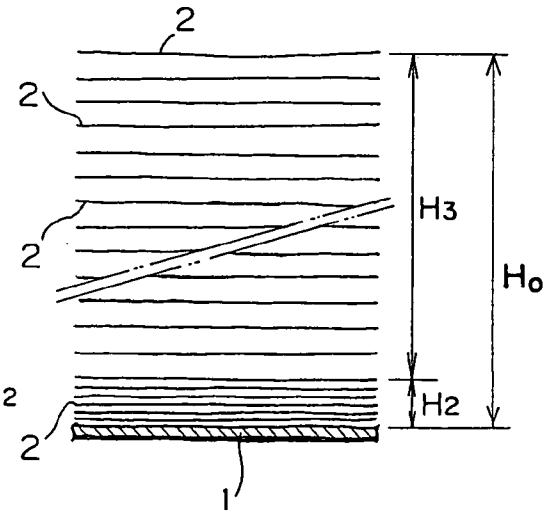

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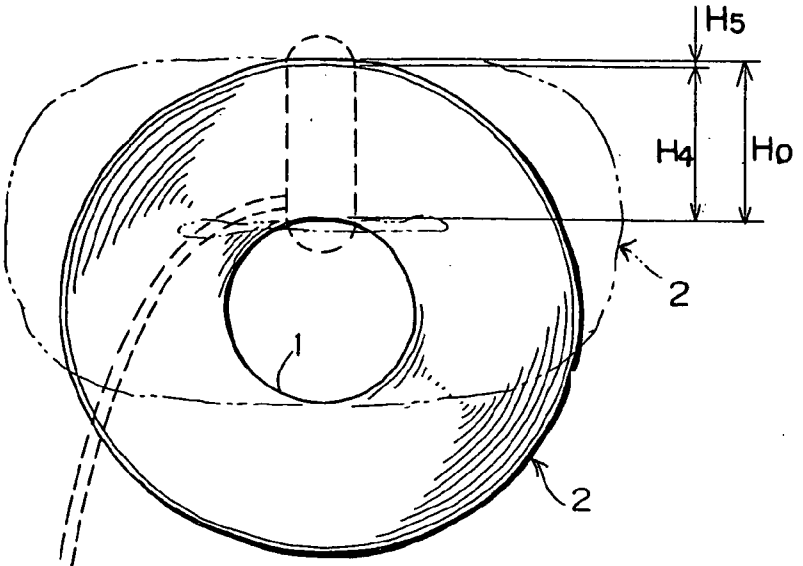

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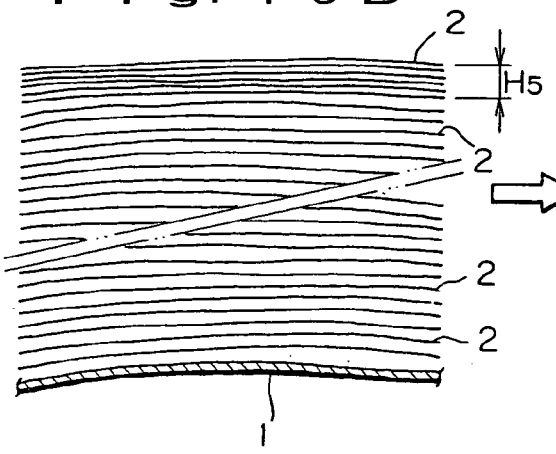

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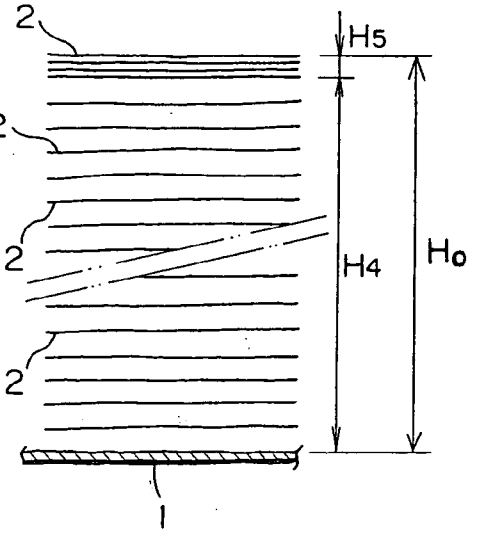

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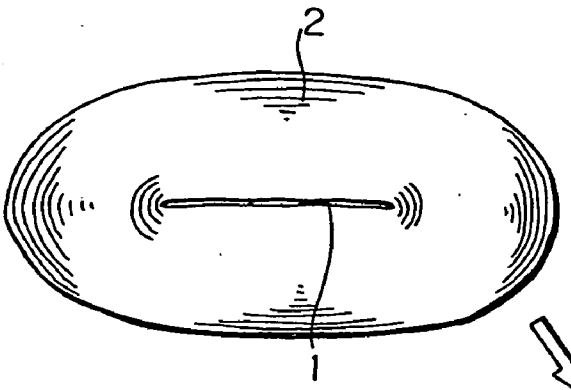

Fig. 14B

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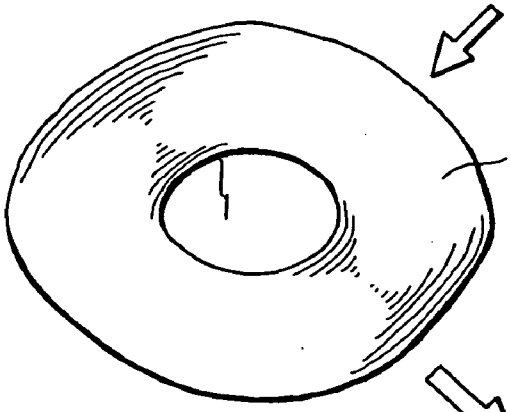

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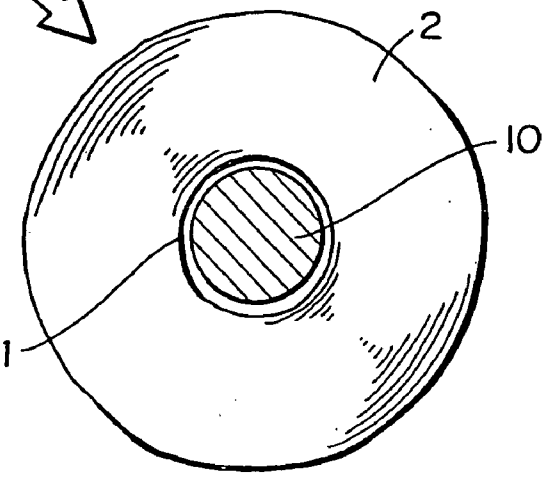

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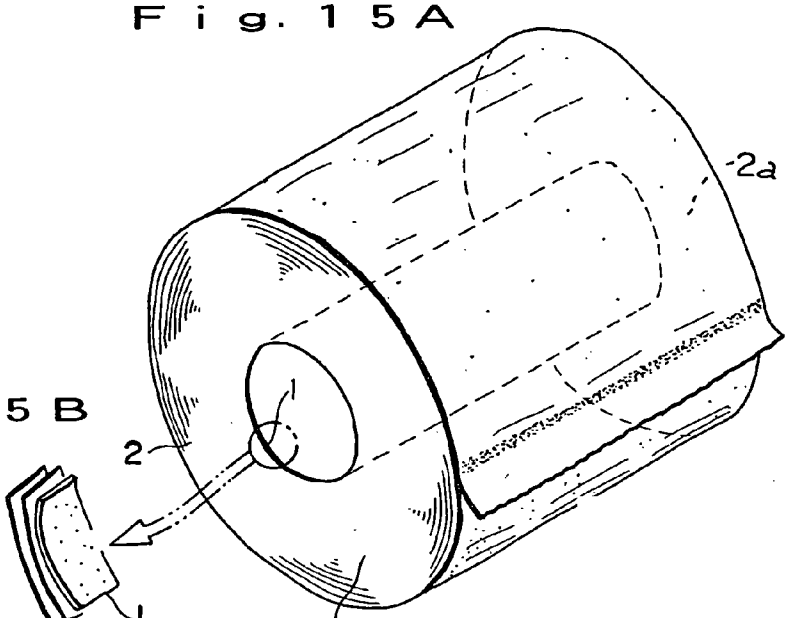
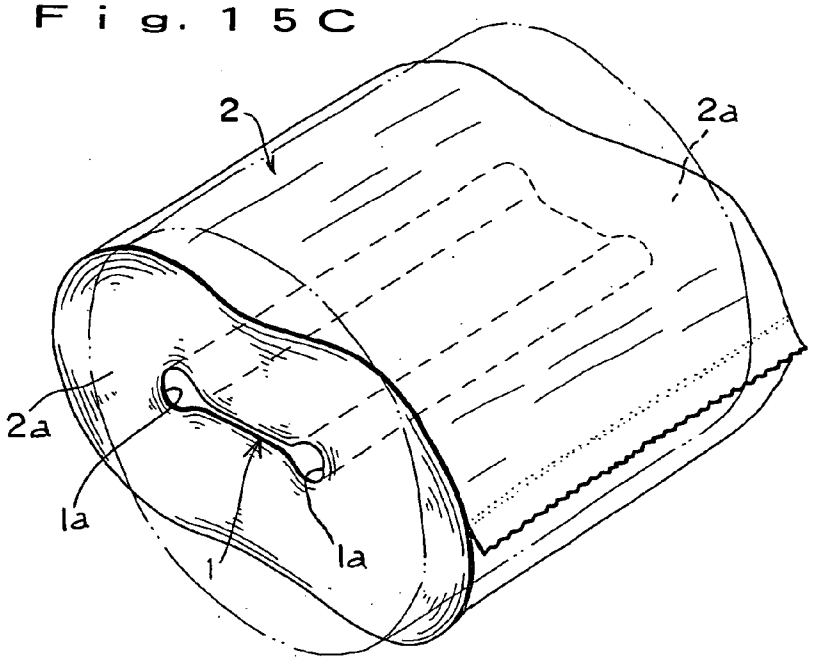


Fig. 15B

Fig. 15C



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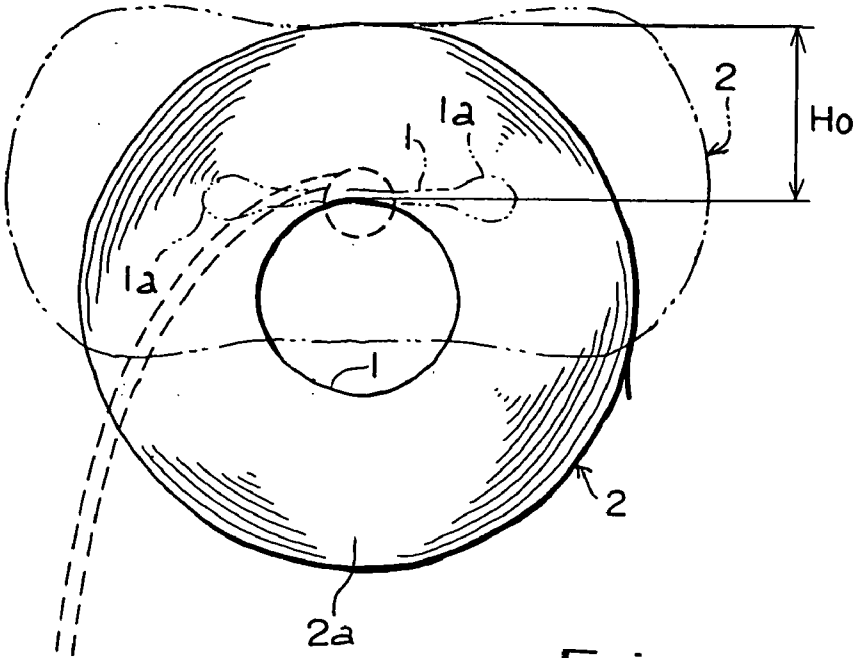

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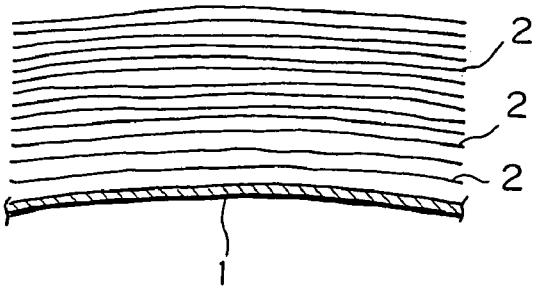

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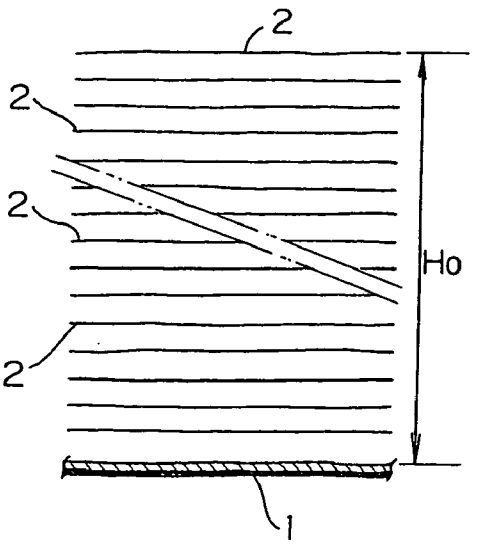

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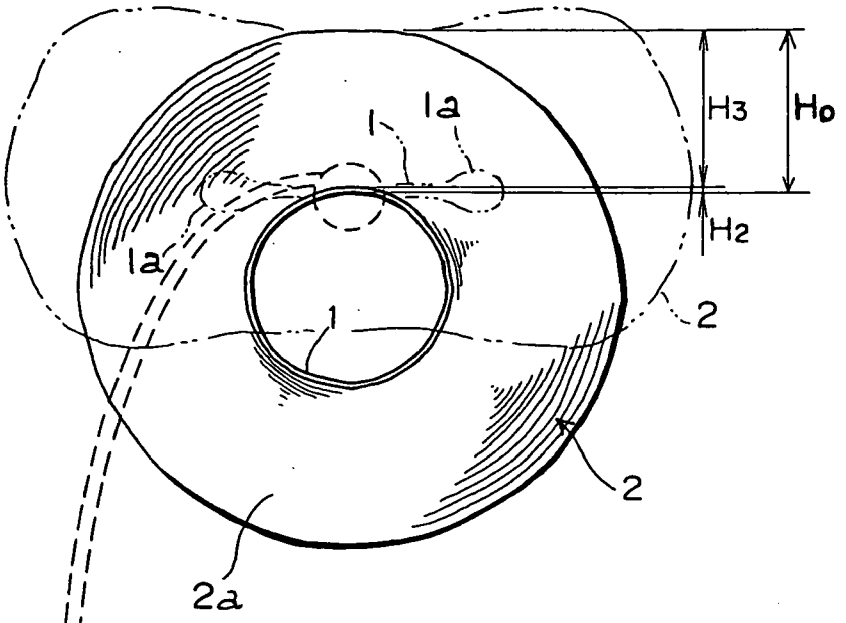

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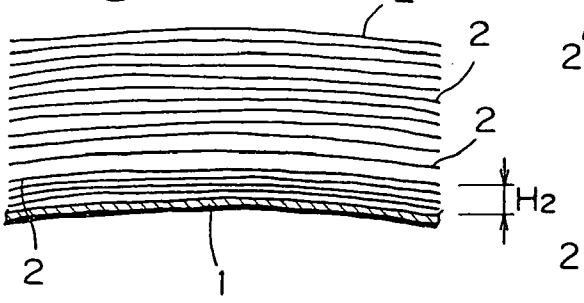

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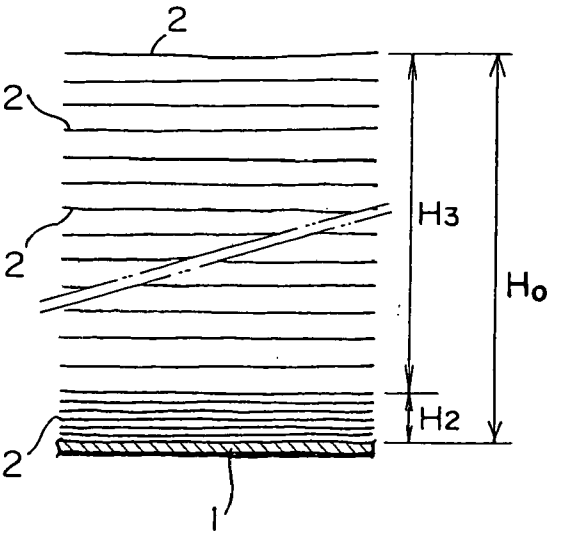

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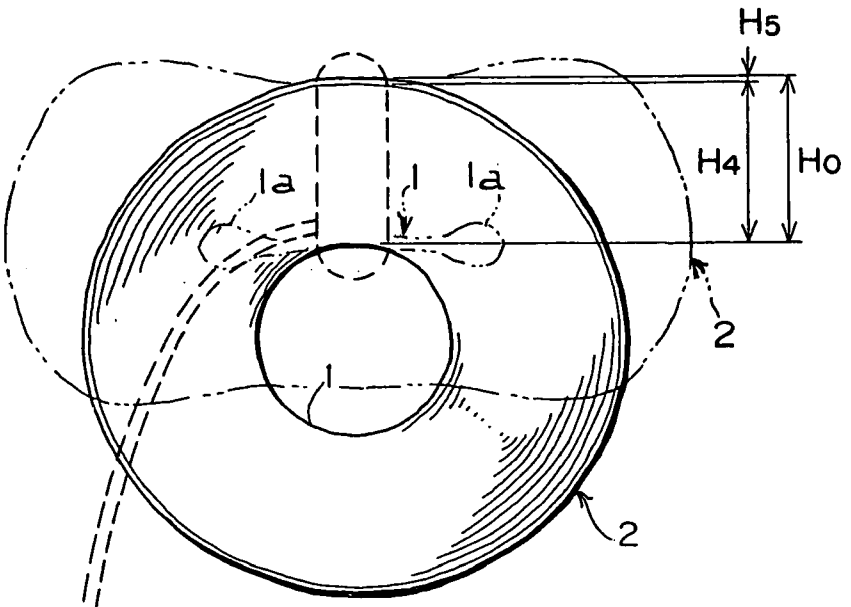

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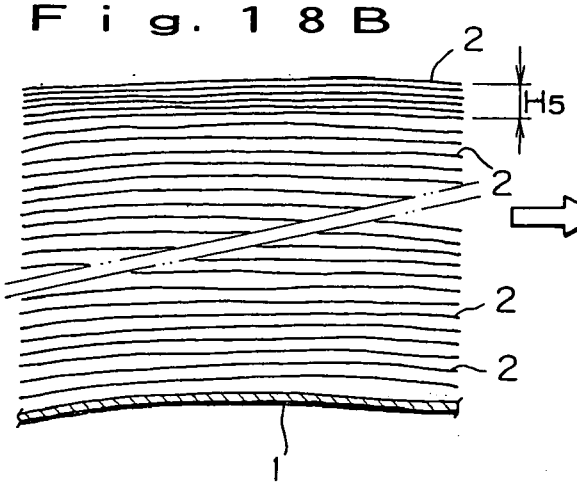

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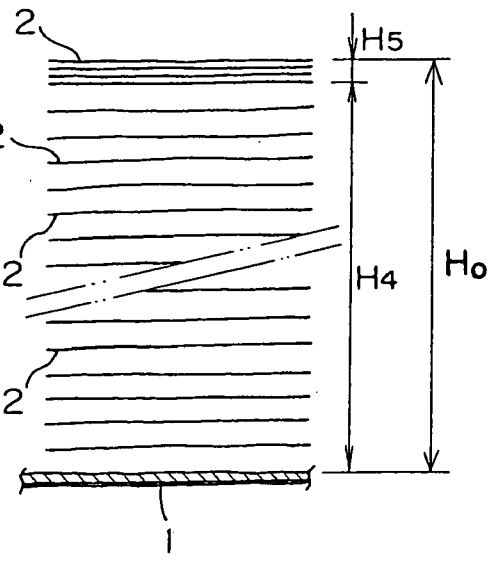


Fig. 19A

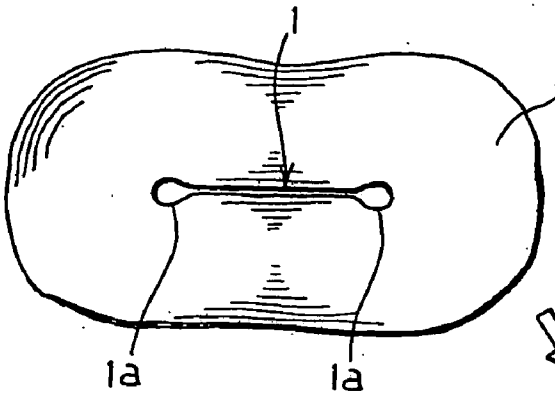
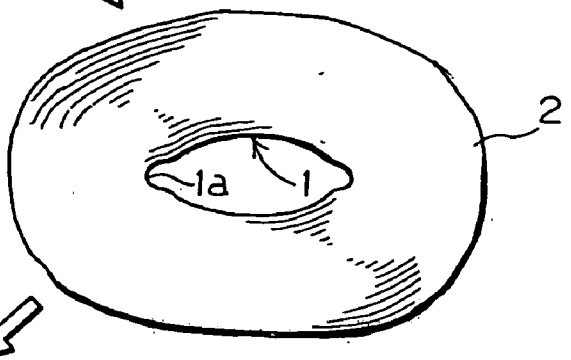


Fig. 19B



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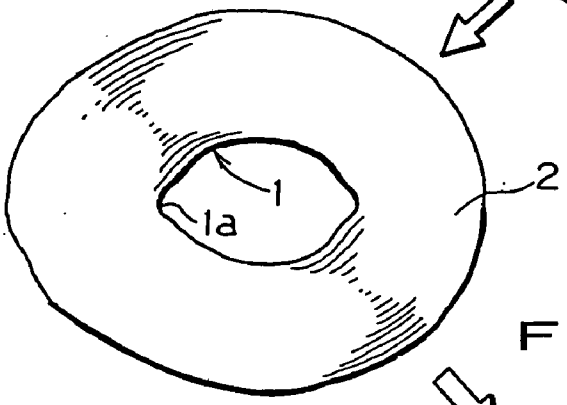
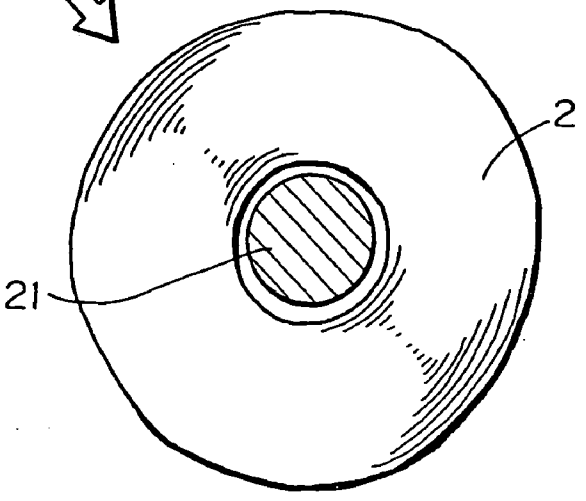


Fig. 19D



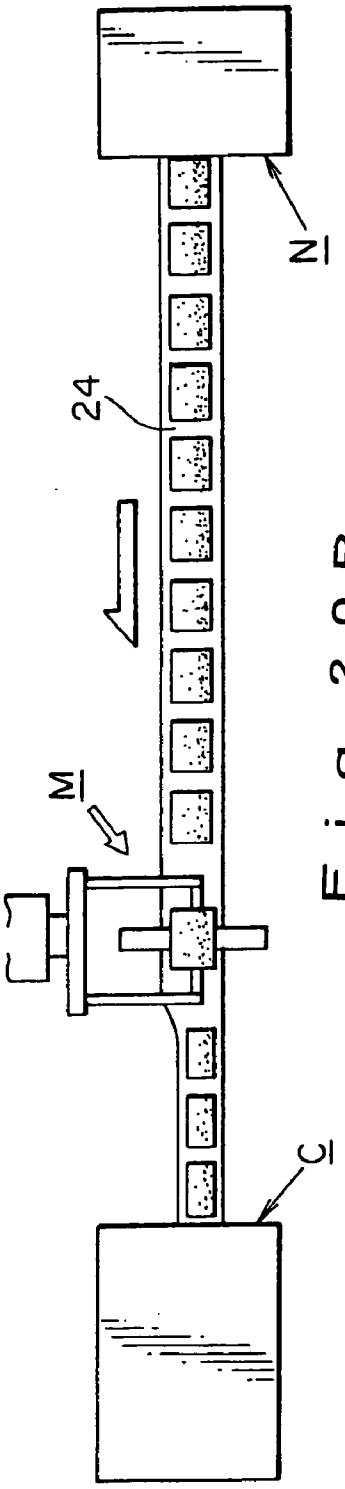


Fig. 20A

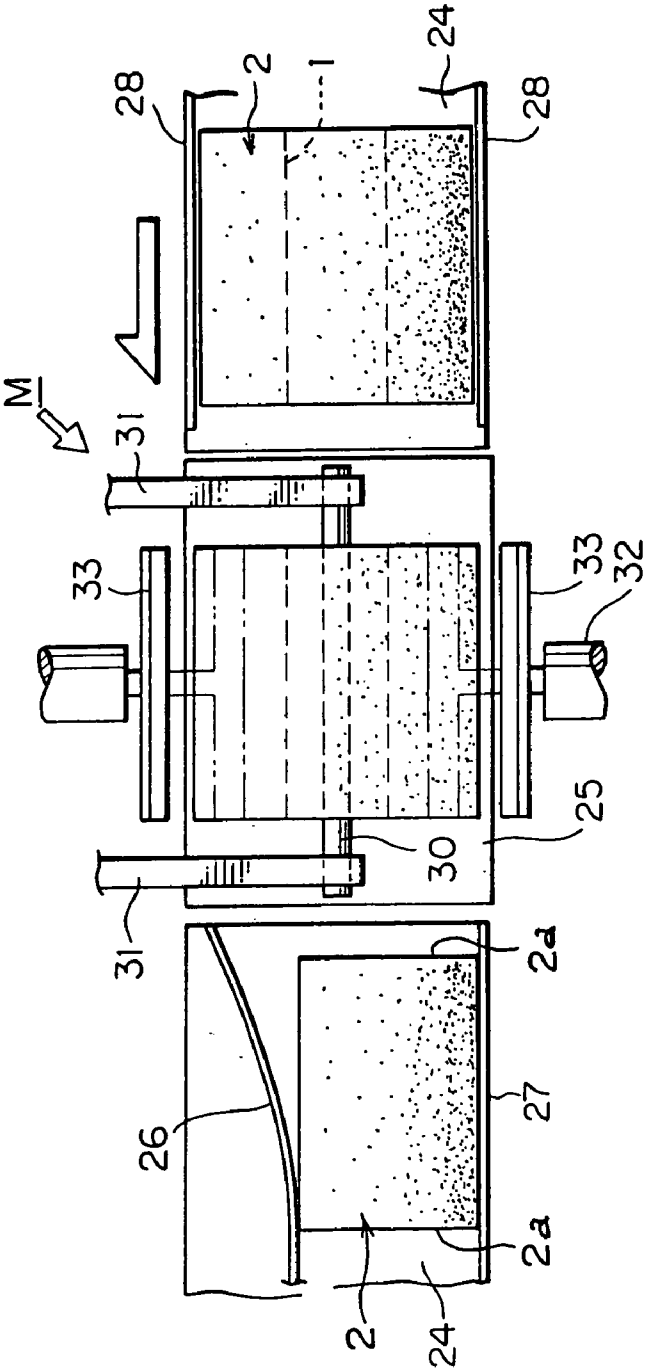


Fig. 20B

Fig. 21A

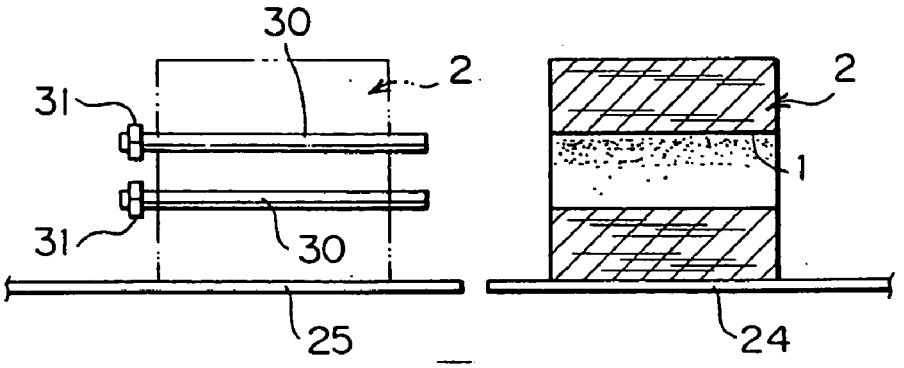


Fig. 21B

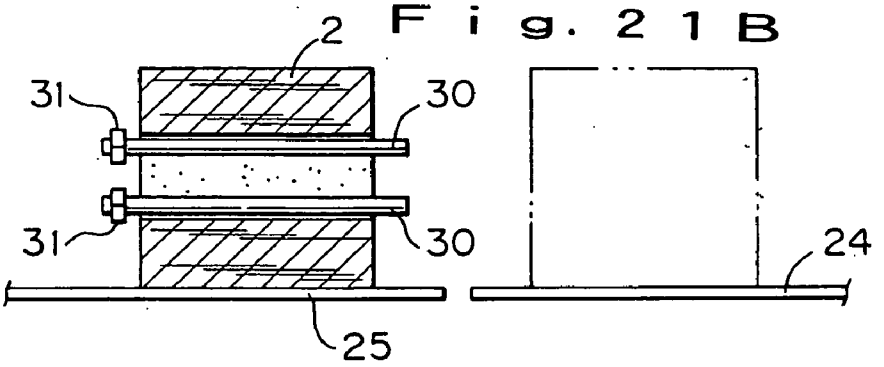


Fig. 21C

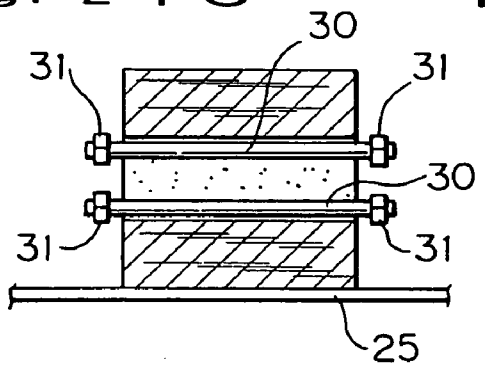


Fig. 21D

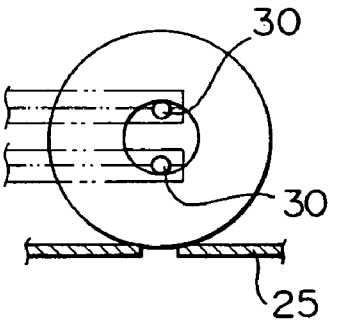


Fig. 21E

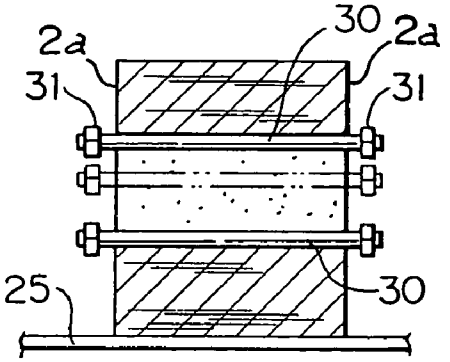


Fig. 21F

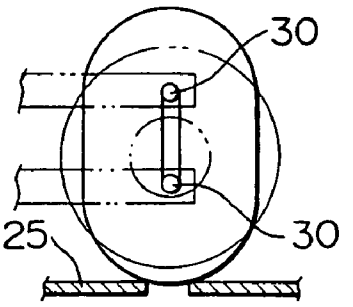


Fig. 22A

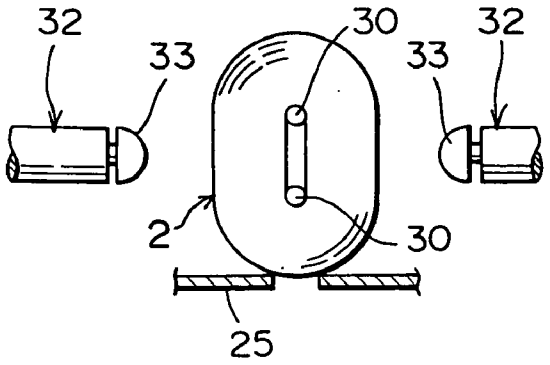


Fig. 22B

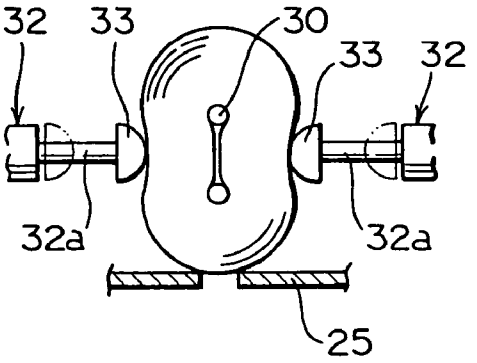


Fig. 22C

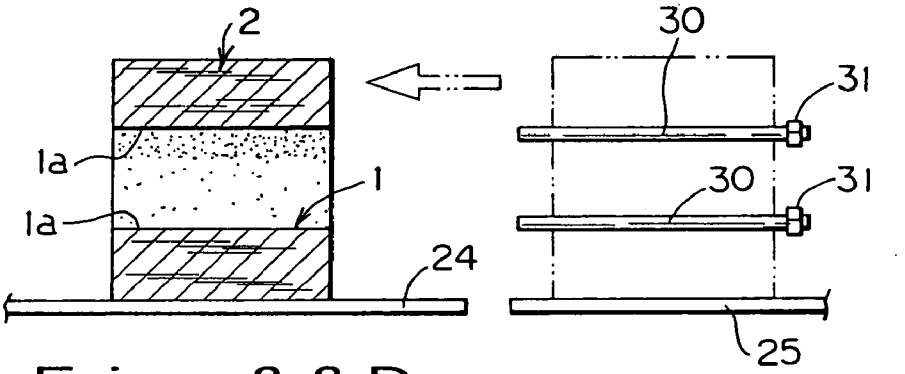


Fig. 22D

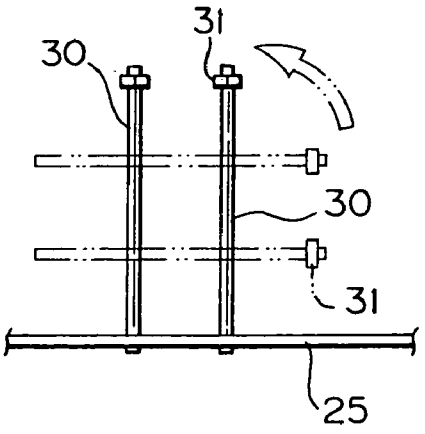


Fig. 22E

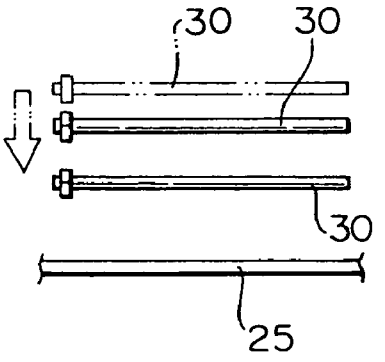


Fig. 23

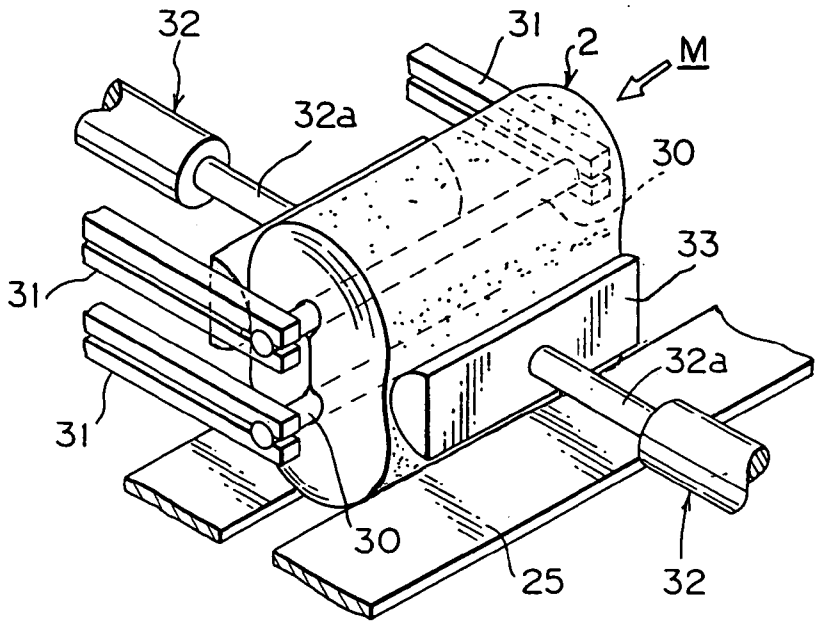


Fig. 24A

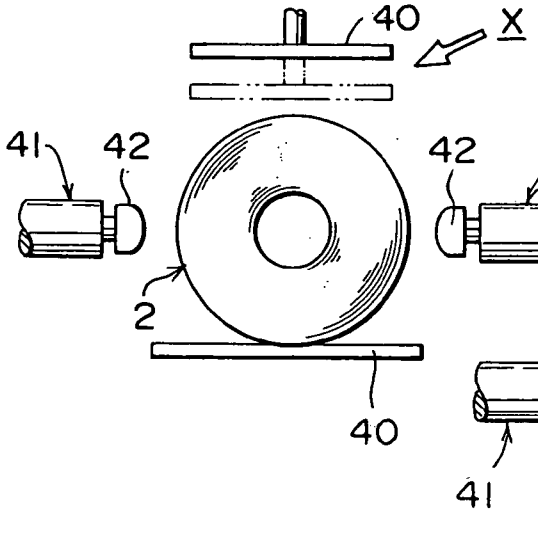
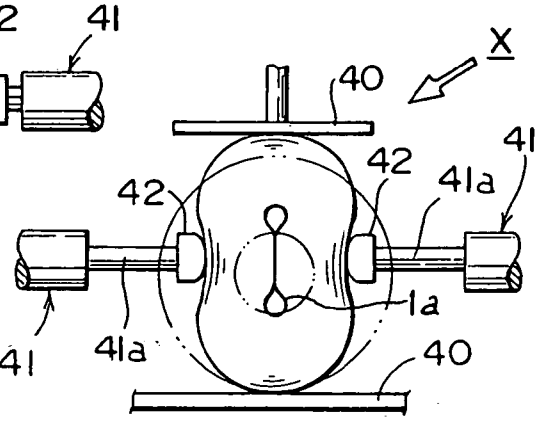


Fig. 24B



RATE OF CHANGE UNDER LOAD CATEGORIZED BY TYPE WHEN UNDER 13KG

LOAD, SCHEMATIC ILLUSTRATION OF MEASUREMENT METHOD AND COMPARISON GRAPH

Fig. 25A

RATE OF CHANGE UNDER LOAD CATEGORIZED BY TYPE (UNIT: %)

CLASSIFICATION	ITEM	MAXIMUM RATE OF CHANGE UNDER LOAD	AVERAGE RATE OF CHANGE UNDER LOAD	MINIMUM RATE OF CHANGE UNDER LOAD
	PRODUCT OF PRESENT INVENTION (60m)	55.5	52.7	49.9
CENTER WOUND	LOOSELY WOUND WITH CORE A (30m × 2P) LOOSELY WOUND WITH CORE B (30m × 2P)	48.5	43.4	38.3
SURFACE WOUND	NORMALLY WOUND WITH CORE (30m × 2P)	34.1	31.2	28.3
	TIGHTLY WOUND WITH CORE (100m)	14.5	12.7	10.8
	TIGHTLY WOUND NO CORE (130m)	6.5	5.1	3.7

Fig. 25B

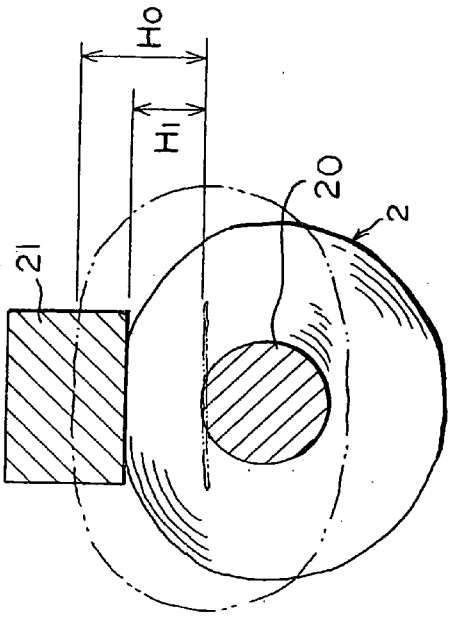


Fig. 25C

COMPARISON GRAPH

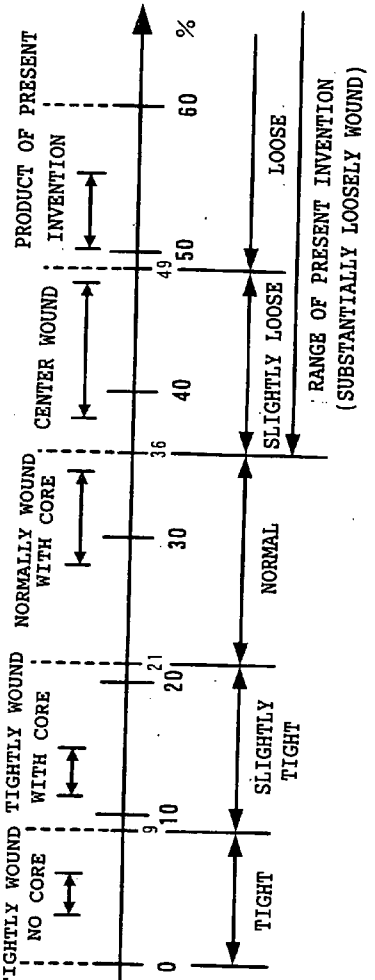


Fig. 26

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

ITEM / CLASSIFICATION	SAMPLE No.	13Kg LOAD		
		H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
PRODUCT OF PRESENT INVENTION (60m)	1	39. 2	18. 2	53. 6
	2	38. 2	17. 0	55. 5
	3	38. 0	19. 0	50. 0
	4	37. 4	18. 2	51. 3
	5	38. 1	19. 1	49. 9
	6	37. 5	17. 5	53. 3
	7	37. 0	17. 9	51. 6
	8	38. 8	18. 9	51. 3
	9	40. 0	19. 3	51. 8
	10	38. 5	19. 3	49. 9
	TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
		55. 5	52. 7	49. 9

RATE OF CHANGE UNDER LOAD = (H0 - H1) / H0 X 100 (%)

H0 : HEIGHT UNDER NO LOAD

H1 : HEIGHT UNDER 13KG LOAD

Fig. 27

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

CLASSIFICATION / ITEM		SAMPLE No.	13Kg LOAD		
			H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
CENTER WOUND	(SLIGHTLY LOOSELY WOUND) LOOSELY WOUND WITH CORE A (30 ε × 2P)	1	31.1	17.2	44.7
		2	33.0	17.0	48.5
		3	31.9	17.0	46.7
		4	31.5	18.3	41.9
		5	31.7	17.8	43.8
		6	33.3	18.0	45.9
		7	31.5	17.4	44.8
		8	34.1	18.1	46.9
		9	31.0	17.0	45.2
		10	33.2	18.1	45.5
		TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
			48.5	45.2	41.9

Fig. 28

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

CLASSIFICATION / ITEM		SAMPLE No.	13Kg LOAD		
			H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
CENTER WOUND	(SLIGHTLY LOOSELY WOUND) LOOSELY WOUND WITH CORE B (30 E x 2P)	1	34. 6	19. 0	45. 1
		2	34. 2	20. 1	41. 2
		3	34. 2	20. 1	41. 2
		4	33. 1	19. 0	42. 6
		5	33. 1	20. 0	39. 6
		6	33. 3	20. 1	39. 6
		7	33. 3	20. 2	39. 3
		8	34. 0	19. 9	41. 5
		9	33. 9	20. 9	38. 3
		10	33. 5	20. 3	39. 4
		TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
			45. 1	41. 7	38. 3

Fig. 29

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

CLASSIFICATION / ITEM		SAMPLE No.	13Kg LOAD		
			H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
SURFACE WOUND	(WOUND AT NORMAL TIGHTNESS) NORMALLY WOUND WITH CORE (30 E × 2P)	1	35. 1	25. 0	28. 8
		2	35. 0	24. 3	30. 6
		3	35. 1	24. 9	29. 1
		4	34. 9	23. 0	34. 1
		5	35. 3	23. 3	34. 0
		6	35. 2	24. 0	31. 8
		7	35. 0	24. 0	31. 4
		8	34. 3	22. 6	34. 1
		9	33. 1	22. 8	31. 1
		10	33. 2	23. 8	28. 3
		TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
			34. 1	31. 2	28. 3

Fig. 30

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

CLASSIFICATION / ITEM		SAMPLE No.	13Kg LOAD		
			H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
SURFACE WOUND	(SLIGHTLY TIGHTLY WOUND) TIGHTLY WOUND WITH CORE (100 E)	1	43.5	37.2	14.5
		2	42.2	37.5	11.1
		3	41.3	36.3	12.1
		4	42.1	36.3	13.8
		5	41.5	36.7	11.6
		6	41.9	36.7	12.4
		7	41.7	37.2	10.8
		8	42.8	37.1	13.3
		9	42.0	36.5	13.1
		10	42.0	37.0	11.9
		TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
			14.5	12.7	10.8

Fig. 31

MEASUREMENT DATA TABLE FOR RATE OF CHANGE UNDER LOAD

ITEM / CLASSIFICATION		SAMPLE No.	13Kg LOAD		
			H_0 [mm]	H_1 [mm]	RATE OF CHANGE UNDER LOAD (%)
SURFACE WOUND	(TIGHTLY WOUND) TIGHTLY WOUND NO CORE (130 ㎜)	1	40. 2	37. 6	6. 5
		2	39. 1	37. 1	5. 1
		3	39. 2	37. 0	5. 6
		4	38. 2	36. 8	3. 7
		5	39. 3	37. 4	4. 8
		6	39. 0	37. 0	5. 1
		7	39. 9	37. 4	6. 3
		8	40. 1	38. 2	4. 7
		9	39. 5	37. 6	4. 8
		10	40. 5	37. 9	6. 4
		TOTAL 10 ITEMS	MAXIMUM RATE OF CHANGE UNDER LOAD[%]	AVERAGE RATE OF CHANGE UNDER LOAD[%]	MINIMUM RATE OF CHANGE UNDER LOAD[%]
			6. 5	5. 1	3. 7

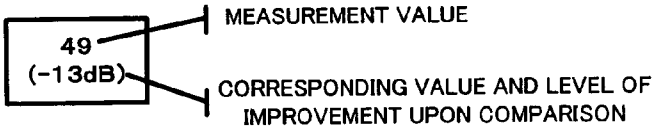
Fig.32

COMPARISON TABLE FOR MEASUREMENT OF UNWINDING NOISE OF TOILET

CLASSIFICATION / ITEM		50cm		1.0m		1.5m	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
CONVENTIONAL NORMALLY WOUND WITH CORE	UPPER TURNS	68	71	62	67	59	63
	INTERMEDIATE	73	76	66	72	62	68
	NEAR PAPER CORE	77	82	72	76	67	71
PRODUCT OF PRESENT INVENTION	UPPER TURNS	53	57	49 (−13dB)	53 (−14dB)	46 (−13dB)	48 (−13dB)
	INTERMEDIATE	59	63	54 (−12dB)	56 (−16dB)	50 (−12dB)	52 (−16dB)
	NEAR PAPER CORE	63	66	56 (−16dB)	59 (−17dB)	51 (−16dB)	54 (−17dB)

−13dB

【GRAPH ANALYSIS】



【MEASUREMENT CONDITIONS】

1. MEASUREMENT LOCATION: INSIDE QUALITY CONTROL ROOM WITH CONSTANT TEMPERATURE AND HUMIDITY (NOISE LEVEL OF ROOM PRIOR TO EXPERIMENT = 37dB)
2. INSTALLATION: DISTANCE BETWEEN HOLDER SIDE AND SENSOR: APPROXIMATELY 50cm, 1m, 1.5m
3. HOLDER: PLASTIC ONE-TOUCH HOLDER
4. UNWINDING RATE: APPROXIMATELY 60m/MINUTE (ASSUMED UNWINDING RATE DURING ACTUAL USE)

EACH SAMPLE WAS MEASURED 5 TIMES AND THE RESULTS COLLATED IN THE TABLE ABOVE

Fig. 33

COMPARISON GRAPH FOR TOILET ROLL UNWINDING NOISE

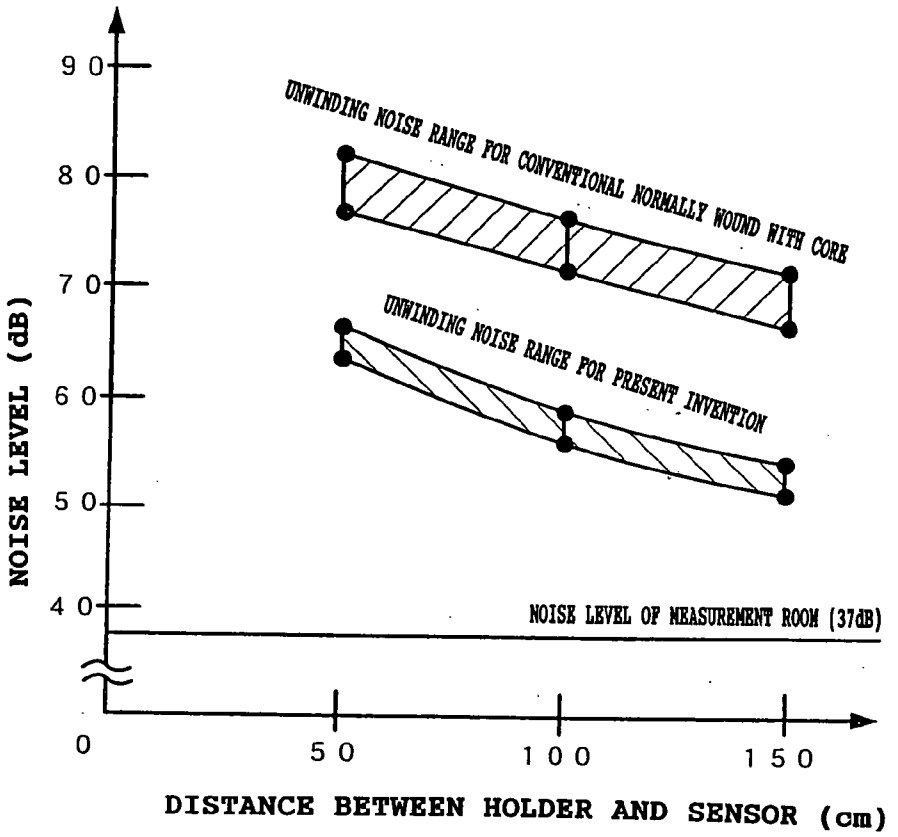


Fig. 34

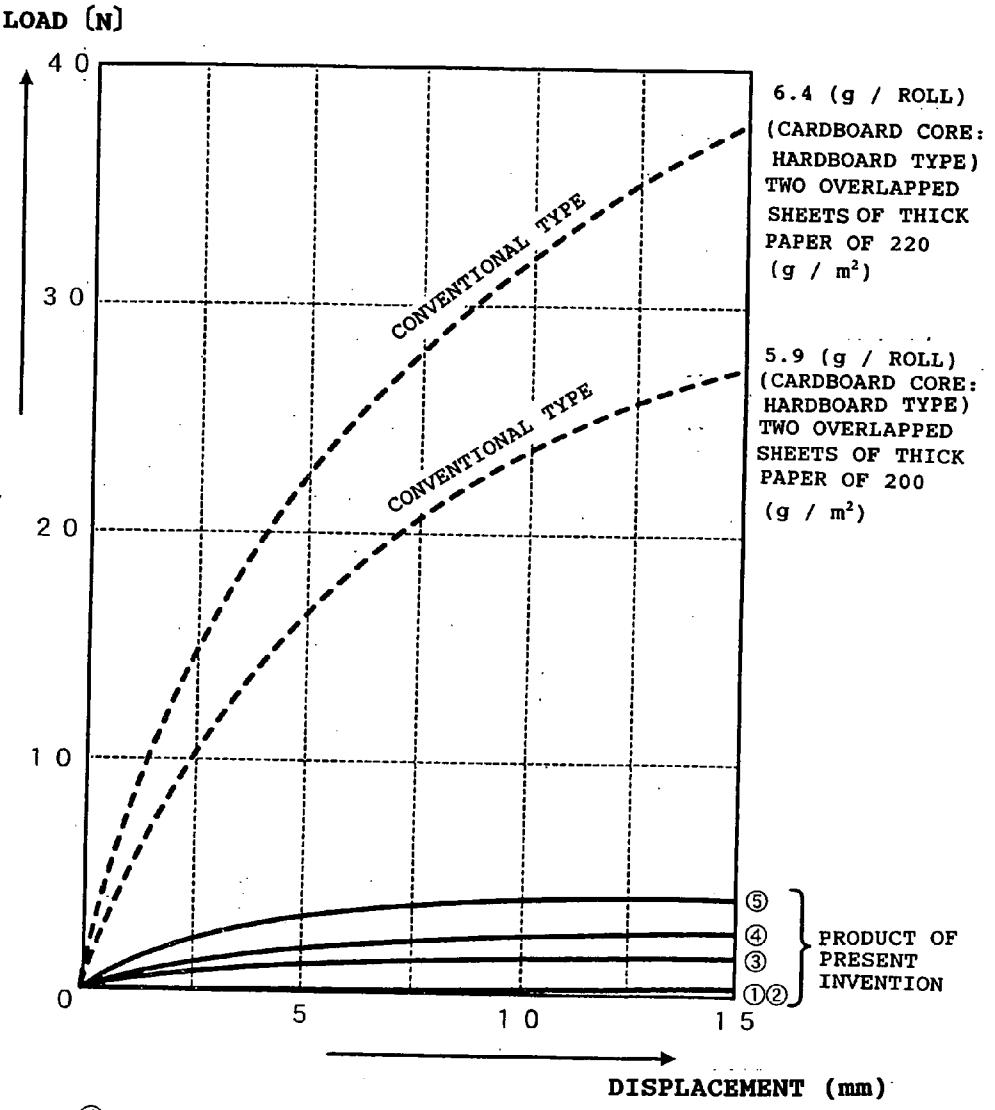
COMPARISON TABLE OF FAMILIAR NOISES AND NOISE LEVELS

0	LOWEST LIMIT OF AUDIBILITY
20	SOUND OF RUSTLING LEAVES
30	WHISPERING
40	LATE AT NIGHT IN A CITY / LIBRARY / AFTERNOON IN A QUIET RESIDENTIAL AREA
50	QUIET OFFICE
60	NORMAL CONVERSATION
70	NOISY OFFICE / TELEPHONE RING
80	INSIDE A TRAIN
90	NOISY FACTORY / SOLO VOCAL PERFORMANCE WITH LOUD VOICE
100	NOISE OF TRAIN PASSING FROM UNDER AN UNDERPASS

(PROPERTY OF KYUSHU ENVIRONMENTAL EVALUATION ASSOCIATION)

Fig. 35

LINE DIAGRAM OF TOILET ROLL PAPER TUBE COMPRESSIVE LOAD DISPLACEMENT



⑤ 3.0 (g / ROLL), WOODFREE PAPER (TWO OVERLAPPED SHEETS OF 100 (g /m²)

④ 2.4 (g / ROLL), WOODFREE PAPER (TWO OVERLAPPED SHEETS OF 80 (g /m²)

③ 2.0 (g / ROLL), WOODFREE PAPER (TWO OVERLAPPED SHEETS OF 65 (g /m²)

② 1.6 (g / ROLL), MG POSTER PAPER (TWO OVERLAPPED SHEETS OF 50 (g /m²)

① 1.0 (g / ROLL), MG POSTER PAPER (TWO OVERLAPPED SHEETS OF 30 (g /m²)

Fig. 36

LINE DIAGRAM OF TOILET PAPER ROLL COMPRESSIVE LOAD DISPLACEMENT

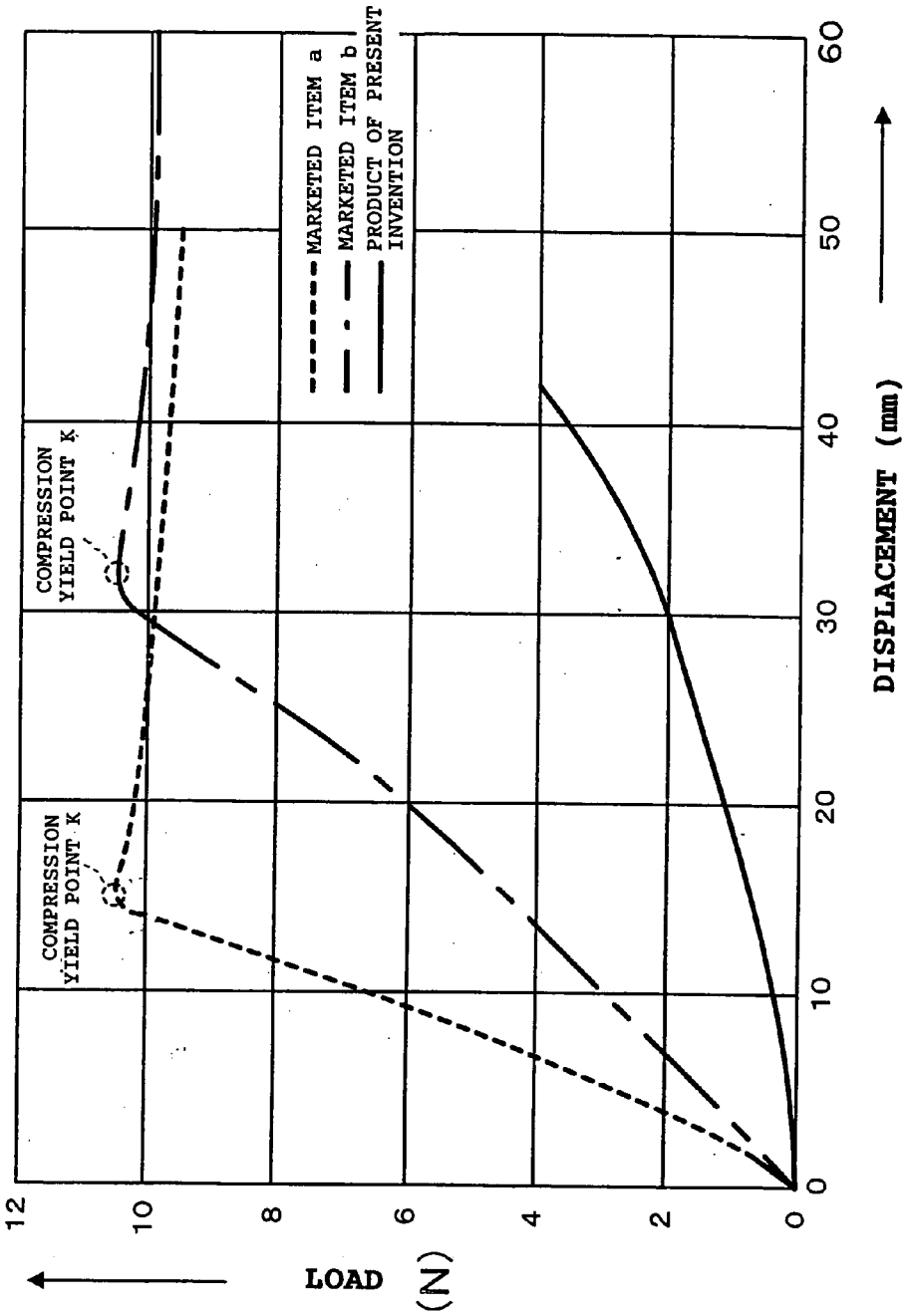


Fig. 37

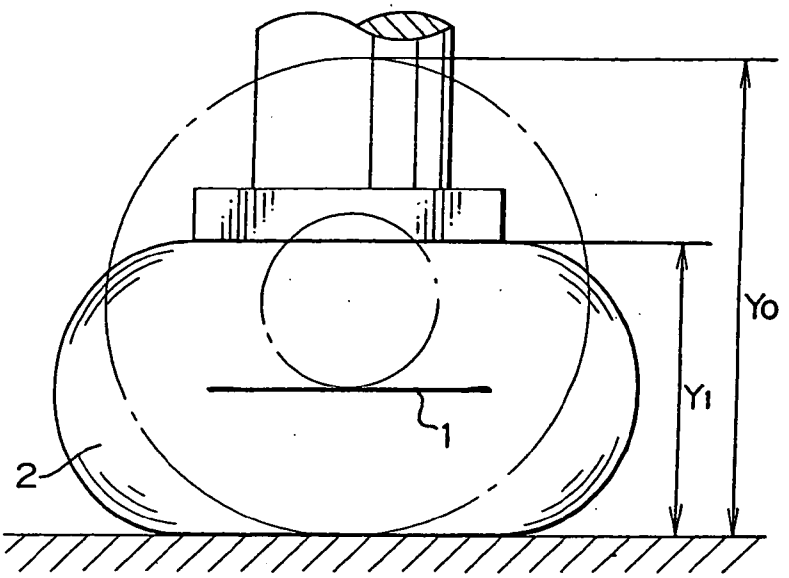


Fig. 38A

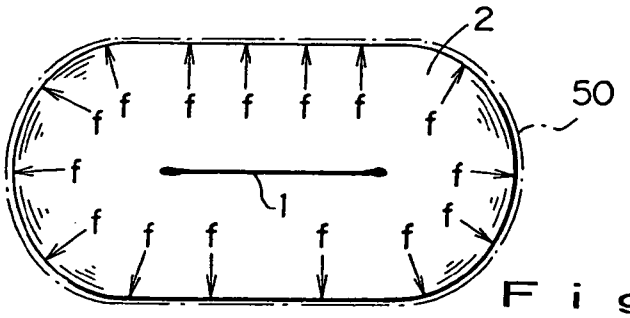


Fig. 38B

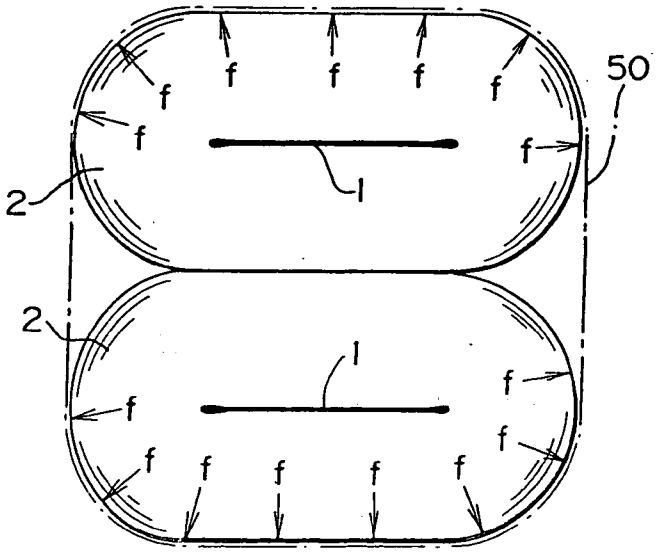


Fig. 39

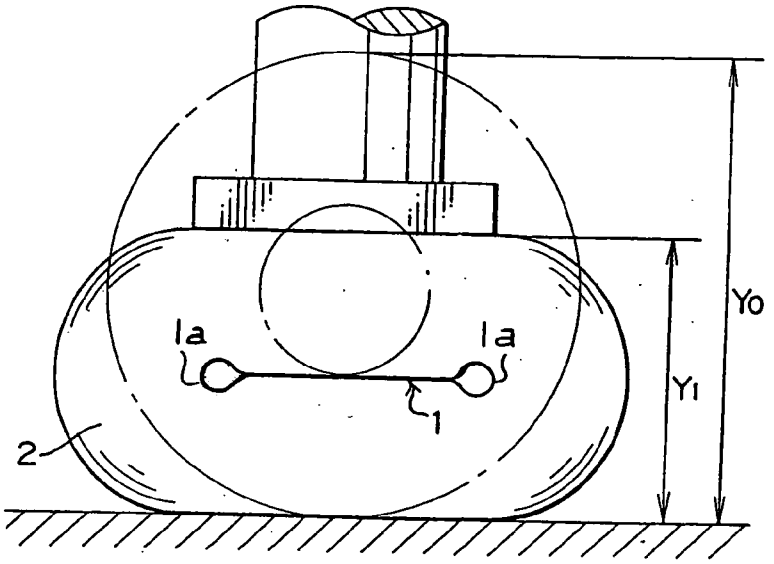


Fig. 40A

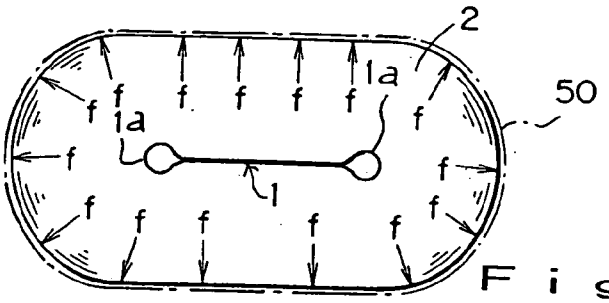


Fig. 40B

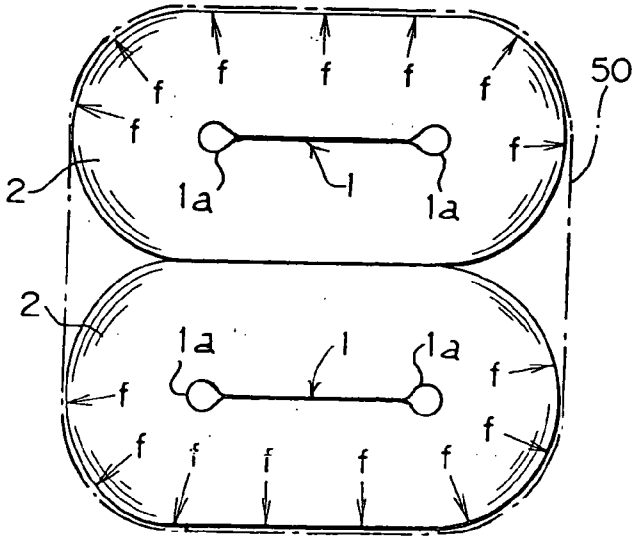


Fig. 41A

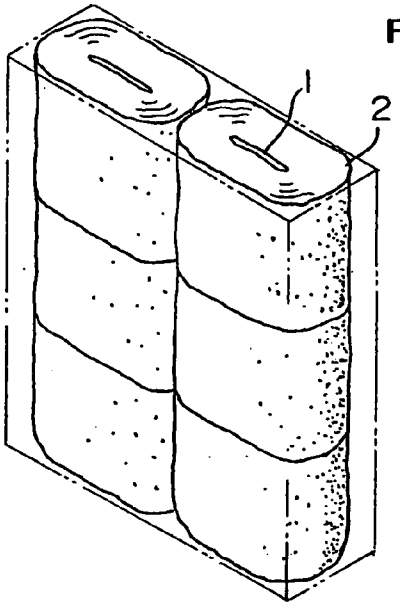


Fig. 41B

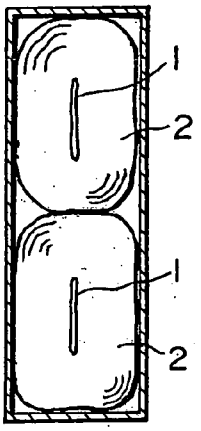


Fig. 41C

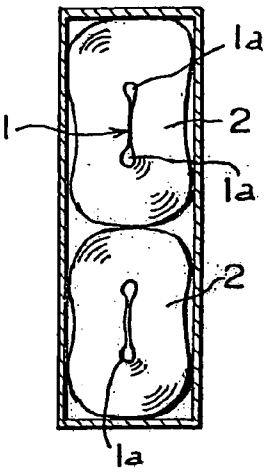


Fig. 42A

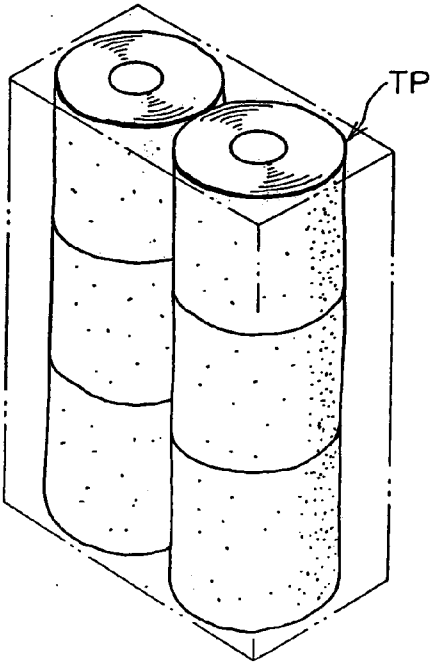


Fig. 42B

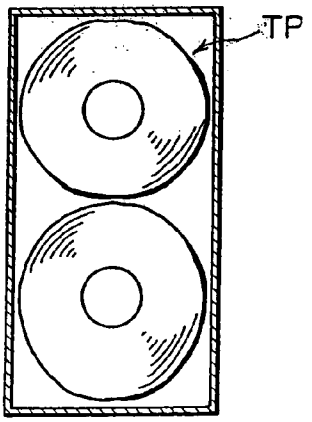


Fig. 43A

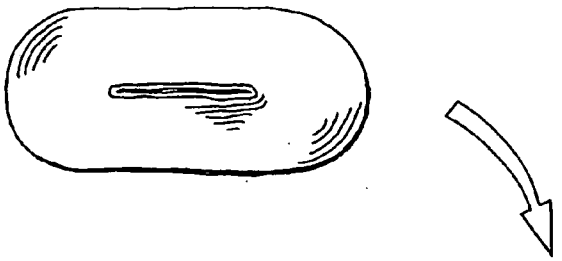


Fig. 43B

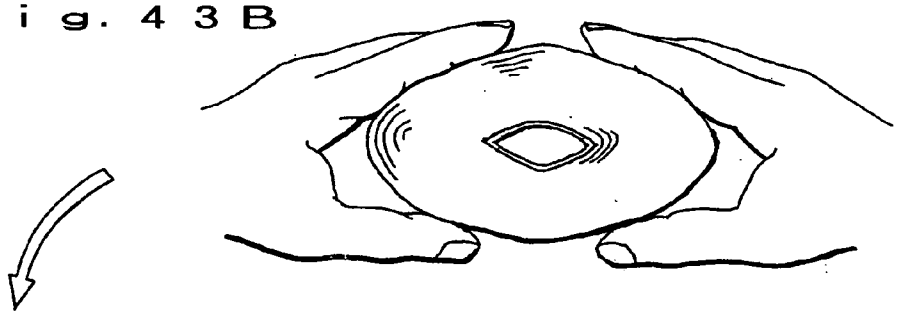


Fig. 43C

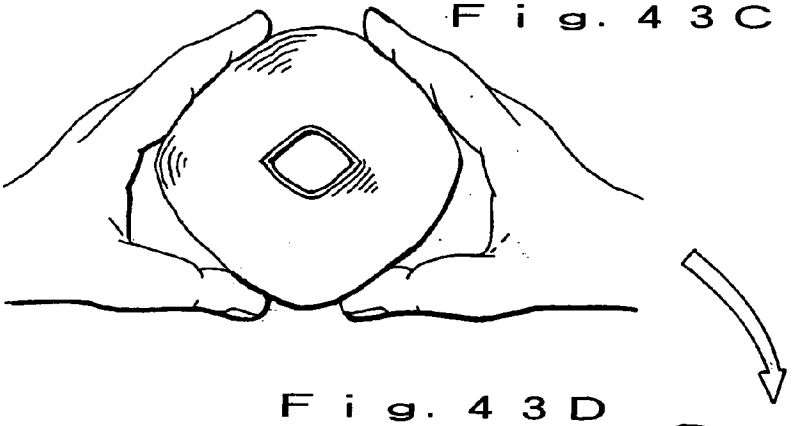


Fig. 43D

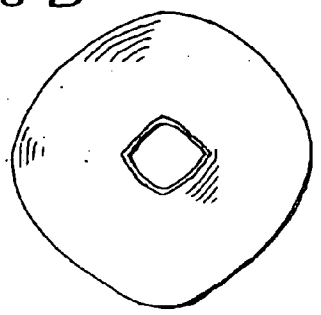


Fig. 44A

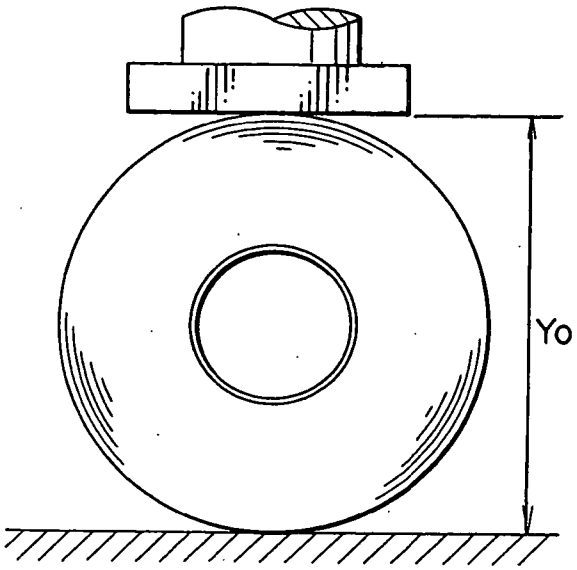


Fig. 44B

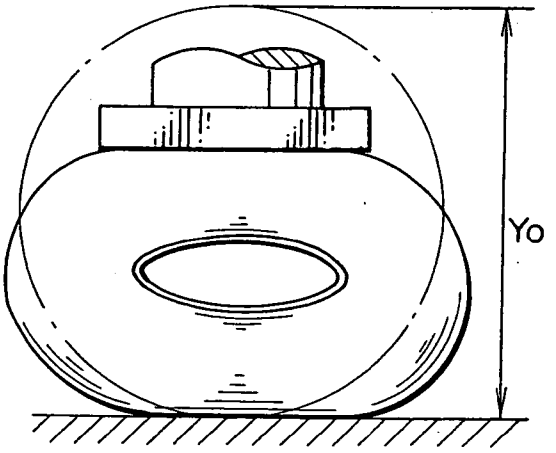
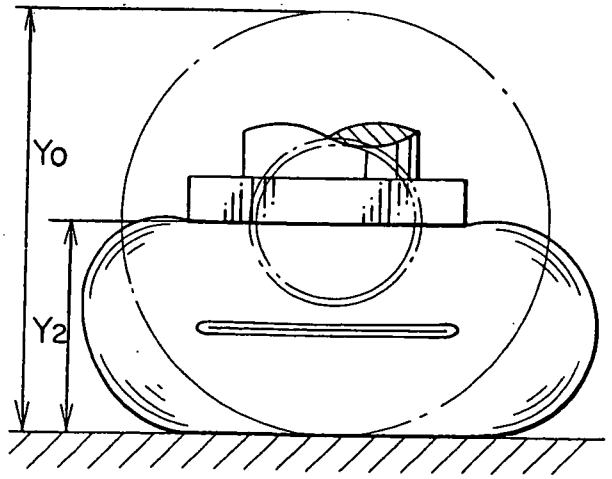


Fig. 44C



TOILET PAPER ROLL AND METHOD OF MANUFACTURING THE PAPER ROLL

TECHNICAL FIELD

[0001] The present invention relates to a toilet paper roll having a thick tubular core which is mountable on a thick shaft portion of a typical household toilet paper roll holder, and a method of manufacturing the paper roll.

BACKGROUND ART

[0002] In a typical conventional toilet paper roll, the toilet paper and a paper tube (core) are provided separately, the core being a tubular body formed from a thick paper material made of cardboard with a diameter of approximately 3.8 cm up to approximately 4.5 cm. In recent years, on the other hand, a so-called core-less toilet paper roll, comprising the toilet paper and a core formed from one part of the toilet paper in the central part of the roll into which the toilet paper is wound, has been researched, developed, and has arrived on the market.

[0003] Two types of this core-less toilet paper roll exist: a type in which the inner diameter of the hole in the center of the roll is particularly small, and a type in which the inner diameter of the hole is large so as to be mountable on a thick shaft portion of a typical household toilet paper roll holder. The type in which the inner diameter of the hole is small is used when the diameter of the shaft portion of the holder also has a small diameter, and is therefore unfavorable since it cannot be used with the thick shaft portion of a toilet paper roll holder used in a typical household.

[0004] Regardless of whether the inner diameter of the central hole of the roll is large or small, almost all of these core-less toilet paper rolls of both kinds are wound substantially tightly from the beginning to the end [of the roll], and there has never existed a roll which is wound loosely. This is because it is believed that in order to form the core from one part of the toilet paper in the center of the wound roll, winding the paper tightly from first to last is a necessary requirement (see Japanese Utility Model Publication H6-47356). Consequently, general markets and users have requested the development of a loosely-wound, loose type core-less toilet paper roll.

[0005] In response to these requests and so on, a loose type core-less toilet paper roll has been developed in which the entire roll is wound substantially loosely, and the initial turns in the central part of the roll are adhered with an adhesive to form a tubular core portion. Although not specified as loose type, an adhered tubular core portion is disclosed in Japanese Patent Application Laid-Open H7-2395. Although such tubular core portions are formed by adhering the point at which the toilet paper is initially loosely wound using an adhesive, there exists no such core-less toilet paper roll that is produced systematically. The outer appearance of the shape of the hole of these tubular core portions is such that the initially wound section generally appears highly irregular, as if the shape of the inner diameter of the hole has been damaged, and it has not been easy to bring familiarity to such products on the market. It is technically difficult to systematically mold the central portions of the roll at the initially wound section of such loose type core-less toilet paper rolls. Another disadvantage is that the machine for manufacturing these loose type core-less toilet paper rolls is of a special specification, meaning that such toilet paper rolls are comparatively extremely expensive to produce.

[0006] Furthermore, a trend has arisen in recent years in which women and the like have taken a great dislike to the rattle-like unwinding noise that is generated during toilet paper roll use. Consequently, there have been requests for the development of a toilet paper roll in which no unwinding noise, or an extremely soft unwinding noise, is produced during use.

[0007] Also, processing of marketed paper toilet paper rolls, and particularly of the paper tube which forms the core in the central portion of the roll following use thereof, is considered a problem. More specifically, since the core is made of a thick cardboard paper material, the core is not easy for women and children to crush, and thus disadvantages arise such as the core being rather bulky to dispose of as refuse. Furthermore, the paper tube cores of these toilet paper rolls are thrown into the lavatories of public toilets and the like, causing many cases of toilet blockages, and it is also to take measures against paper tube cores that the present applicant has developed a core-less type toilet paper roll. A product has also been developed in which the paper tube core can be flushed down the toilet, but this product is expensive and not suited to general use.

[0008] A toilet paper roll in the form of a flat ellipse has also been developed as a product (Japanese Utility Model Application Laid-Open H7-25894), but since the paper tube core is formed from a thick cardboard paper material, a great deal of force is required to work the product into a flat form, and thus a special device has to be used (Japanese Patent Publications H5-21814 and H6-84220). The product is therefore disadvantaged in that the manufacturing cost per unit is high. Moreover, as is illustrated in **FIG. 43**, the paper tube core formed from thick cardboard paper material does not become circular during use, and thus even when mounted on the thick shaft part of a typical household toilet [paper roll] holder, inconveniences arise such as the generation of excessively loud noise.

DISCLOSURE OF THE INVENTION

[0009] In order to solve the aforementioned problems, the present invention comprises a toilet paper roll which is constituted by a thick tubular core manufactured from thin paper and having a diameter of approximately 4 cm and toilet paper **2** which is wound substantially loosely around this thick tubular core from beginning to end. By mounting this on the thick shaft portion of a typical household toilet paper roll holder, unwinding noise can be reduced considerably, refuse processing of the thick tubular core can be performed favorably, the thick tubular core can be manufactured at a reasonable cost, whereby the manufacturing costs of the toilet paper roll can also be reduced, and manufacturing costs can be improved in comparison with a toilet paper roll that is wound entirely loosely up to the core.

[0010] The present invention also comprises a toilet paper roll constituted by a thick tubular core manufactured from thin paper and having a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly in the initial several turns and thereafter wound substantially loosely to the end, thereby being wound substantially loosely as a whole. Although the toilet paper is wound around the thick tubular core tightly in the initial

several turns and thereafter wound substantially loosely to the end, as a whole the toilet paper is wound substantially loosely, and therefore has the same constitution and exhibits the same effects as the aforementioned toilet paper roll, which is wound substantially loosely from beginning to end. The present invention further comprises a toilet paper roll constituted by a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm, and toilet paper which is wound around this thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, thereby being wound substantially loosely as a whole. Here also, being wound around the thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, and thereby being wound substantially loosely as a whole, this toilet paper roll has the same constitution and exhibits the same effects as the aforementioned toilet paper roll, which is wound substantially loosely from beginning to end.

[0011] In the aforementioned three constitutions of the present invention, the thick tubular core is constituted by percolation paper. As a result, the thick tubular core differs from a conventional cardboard paper tube core in that its strength is a great deal weaker, and in that percolation paper has a water-soluble property such that toilet blockages can be avoided even when the thick tubular core which remains on the thick shaft portion of a typical household toilet paper roll holder after use of the toilet paper roll is flushed down the toilet (see **FIG. 9**). Thus, the toilet paper roll is extremely convenient in that after each use thereof, the thick tubular core is not disposed of as general refuse.

[0012] The present invention is also comprised of a toilet paper roll which is constituted by a thick tubular core manufactured from thin paper and having a diameter of approximately 4 cm and toilet paper which is wound substantially loosely around this thick tubular core from beginning to end, wherein this thick tubular core is formed into a flat shape and the toilet paper is also formed into a flat elliptical shape in compliance with the flat thick tubular core. Thus, even though the thick tubular core is flat, the thick tubular core is made of thin paper, and so when the toilet paper roll is mounted onto the thick shaft portion of a toilet paper roll holder, it can be returned to a substantially perfect circle which is adequate for use due to the synergistic action between the loose toilet paper and the fact that almost no pressure is applied even when the thick tubular core is flattened. Further, since the toilet paper roll has a flat elliptical form, advantages are obtained over a conventional perfectly circular toilet paper roll in that space can be greatly economized such that storage and transportation costs can be reduced.

[0013] The present invention is further comprised by a toilet paper roll which is constituted by a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly in the initial several turns and thereafter wound substantially loosely to the end, thereby being wound substantially loosely as a whole, wherein the thick tubular core is formed into a flat shape and the toilet paper is also formed into a flat elliptical shape in compliance with the flat thick tubular core, or which is constituted by a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, thereby being wound substantially loosely as a whole, wherein the thick tubular core is formed into a flat shape and the toilet paper is also formed into a flat elliptical shape in compliance with the flat thick tubular core.

[0014] The present invention is further comprised by a toilet paper roll constituted by a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound substantially loosely around this thick tubular core from beginning to end, wherein the thick tubular core is formed into a substantially flat shape having fig-like expanded portions on both sides, and the toilet paper is also formed into a flat elliptical shape in compliance with the substantially flat thick tubular core. Thus, even though the thick tubular core is flat, the thick tubular core is made of thin paper, and so when the toilet paper roll is mounted onto the thick shaft portion of a toilet paper roll holder, it can be returned to a substantially perfect circle which is adequate for use due to the synergistic action between the loose toilet paper and the fact that almost no pressure is applied even when the thick tubular core is flattened and has fig-like expanded portions on both sides, and due to the absence of kinks because of the existence of the expanded parts. Further, since the toilet paper roll has a flat elliptical form, advantages are obtained over a conventional perfectly circular toilet paper roll in that space can be greatly economized such that storage and transportation costs can be reduced.

[0015] The present invention is further comprised by a toilet paper roll of the aforementioned constitution which is formed such that during the formation of the toilet paper into a flat elliptical shape, there exists no compression yield point at which, when a compressive load of a prescribed value is applied to a semi-manufactured toilet paper roll, the amount of displacement increases even without applying increased pressure beyond the prescribed value, and such that the amount of displacement only increases with the gradual application of pressure of half or less than half of the compressive load of the prescribed value. Thus, the semi-manufactured toilet paper roll can be systematically formed into a flat elliptical shape with the application of slight pressure of half or less than half of the compressive load of the prescribed value. In particular, since the compression yield point K, at which the amount of displacement increases even without the application of further pressure, does not exist upon reaching the compressive load of the prescribed value, no large machine for forming the toilet paper roll into a flat elliptical shape is necessary, and since little force is required to return the toilet paper roll to its original circular shape, packaging of the flat elliptical toilet paper rolls can be easily achieved using a simple device or the like. Conversely, when there is a cardboard paper tube core such as in marketed items a and b in **FIGS. 36 and 44**, the compressive yield point K, having a prescribed value which is a large compressive load, exists, and therefore a large force is required to compress the core. As a result, when the toilet paper roll is placed in a bag or the like, great repulsive force is necessary to return the toilet paper roll from an elliptical form to a circular form, and a large sealing device must be employed. These conventional inconveniences have been eliminated by the present invention.

[0016] The present invention further comprises a toilet paper roll manufacturing method which comprises the steps of: manufacturing a semi-manufactured toilet paper roll comprising a thick tubular core which is made of thin paper and which has a diameter of approximately 4 cm, and toilet paper which is wound substantially loosely as a whole around this thick tubular core; fixing and supporting this semi-manufactured toilet paper roll in a substantially outer diametrical position with facing pressing support plates; pressing the semi-manufactured toilet paper roll inward at a substantially central position from the two substantially orthogonal directions to the direction of spacing between the two pressing support plates using pressing portions on the ends of hydraulic cylinders; forming the entire thick tubular core into a substantially flat shape while forming fig-like expanded portions on the two end positions of the substantially flat thick tubular core; and also forming the toilet paper into a flat elliptical shape in compliance with the substantially flat thick tubular core. The advantage here is that since the semi-manufactured toilet paper roll is supported, the toilet paper roll is prevented from becoming flat, and in this state, due to the synergistic action between the facts that the toilet paper roll is only pressed inward at the center thereof, the thick tubular core is manufactured from thin paper, and the toilet paper is wound substantially loosely as a whole, the fig-like expanded portions can be formed with ease.

[0017] The present invention further comprises a toilet paper roll manufacturing method which comprises the steps of: manufacturing a semi-manufactured toilet paper roll comprising a thick tubular core which is made of thin paper and which has a diameter of approximately 4 cm, and toilet paper which is wound substantially loosely as a whole around this thick tubular core; stretching the thick tubular core by inserting two hole-widening round bars therein; pressing the thick tubular core inward from both sides using hydraulic cylinders in directions which are orthogonal to the spacing between the two hole-widening round bars while forming the thick tubular core into a flat elliptical shape; and forming the entire thick tubular core into a substantially flat shape by forming fig-like expanded portions on both sides of the thick tubular core while also forming the toilet paper into a flat elliptical shape in compliance with the substantially flat thick tubular core. The advantage here is that due to the synergistic action among the two hole-widening round bars, the thin paper thick tubular core, and the toilet paper which is wound substantially loosely as a whole, the fig-like expanded portions can be molded comparatively easily. A further advantage is that this toilet paper roll can be formed into a substantially circular form with no kinks in the thick tubular core thereof upon mounting onto the thick shaft portion of a toilet paper roll holder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] **FIG. 1A** is a perspective view of a toilet paper roll of a first embodiment of the present invention;

[0019] **FIG. 1B** is a partially enlarged perspective view of **FIG. 1A**;

[0020] **FIG. 1C** is a side view of **FIG. 1A and a** rendering of the flat elliptical form during storage and the like [of the toilet paper roll];

[0021] **FIG. 2A** is a side view of the first embodiment of the present invention;

[0022] **FIG. 2B** is a partially enlarged view of **FIG. 2A**;

[0023] **FIG. 2C** is a partial schematic view of **FIG. 2A**;

[0024] **FIG. 3A** is a side view of a second embodiment of the present invention;

[0025] **FIG. 3B** is a partially enlarged view of **FIG. 3A**;

[0026] **FIG. 3C** is a partial schematic view of **FIG. 3A**;

[0027] **FIG. 4A** is a side view of a third embodiment of the present invention;

[0028] **FIG. 4B** is a partially enlarged view of **FIG. 4A**;

[0029] **FIG. 4C** is a partial schematic view of **FIG. 4A**;

[0030] **FIG. 5A** is a view showing the state of unwinding of the present invention;

[0031] **FIG. 5B** is an enlarged cross-sectional view of the S portion of **FIG. 5A**, and a view showing a state in which a sound source is eliminated or reduced;

[0032] **FIGS. 6A and 6B** are views showing the state of the central portion of the toilet paper roll during an unwinding process of the present invention;

[0033] **FIGS. 7A and 7B** are views showing the state of the central portion of the toilet paper roll during the unwinding process of a conventional product;

[0034] **FIG. 8A** is a view showing a normal process to crush a thick tubular core of the present invention;

[0035] **FIG. 8B** is a view showing another state in which the thick tubular core of the present invention is crushed;

[0036] **FIG. 8C** is a view showing a further state in which the thick tubular core of the present invention is crushed;

[0037] **FIGS. 9A through 9E** are views showing states of flushing the thick tubular core of the present invention down a toilet;

[0038] **FIG. 10A** is a perspective view of a semi-manufactured toilet paper roll of a fourth embodiment of the present invention;

[0039] **FIG. 10B** is a partially enlarged perspective view of **FIG. 10A**;

[0040] **FIG. 10C** is a perspective view of the toilet paper roll of the fourth embodiment of the present invention as a finished product, and a rendering of the semi-manufactured product thereof;

[0041] **FIG. 11A** is a side view of the semi-manufactured toilet paper roll of the fourth embodiment of the present invention, and a rendering of the finished product thereof;

[0042] **FIG. 11B** is a partially enlarged view of **FIG. 11A**;

[0043] **FIG. 11C** is a partial schematic view of **FIG. 11A**;

[0044] **FIG. 12A** is a side view of a semi-manufactured toilet paper roll of a fifth embodiment of the present invention, and a rendering of a finished-product thereof;

[0045] **FIG. 12B** is a partially enlarged view of **FIG. 12A**;

[0046] **FIG. 12C** is a partial schematic view of **FIG. 12A**;

[0047] **FIG. 13A** is a side view of a semi-manufactured toilet paper roll of a sixth embodiment of the present invention, and a rendering of a finished product thereof;

[0048] **FIG. 13B** is a partially enlarged view of **FIG. 13A**;

[0049] **FIG. 13C** is a partial schematic view of **FIG. 13A**;

[0050] **FIGS. 14A through 14D** are views of a process to mount the toilet paper rolls of the fourth through sixth embodiments of the present invention on a thick shaft of a toilet paper roll holder by returning the toilet paper roll to its original circular shape;

[0051] **FIG. 15A** is a perspective view of a semi-manufactured toilet paper roll of a seventh embodiment of the present invention;

[0052] **FIG. 15B** is a partially enlarged perspective view of **FIG. 15A**;

[0053] **FIG. 15C** is a perspective view of the toilet paper roll of the seventh embodiment of the present invention as a finished product, and a rendering of the semi-manufactured product thereof;

[0054] **FIG. 16A** is a side view of the semi-manufactured toilet paper roll of the seventh embodiment of the present invention, and a rendering of the finished product thereof;

[0055] **FIG. 16B** is a partially enlarged view of **FIG. 16A**;

[0056] **FIG. 16C** is a partial schematic view of **FIG. 16A**;

[0057] **FIG. 17A** is a side view of a semi-manufactured toilet paper roll of an eighth embodiment of the present invention, and a rendering of a finished product thereof;

[0058] **FIG. 17B** is a partially enlarged view of **FIG. 17A**;

[0059] **FIG. 17C** is a partial schematic view of **FIG. 17A**;

[0060] **FIG. 18A** is a side view of a semi-manufactured toilet paper roll of a ninth embodiment of the present invention, and a rendering of a finished product thereof;

[0061] **FIG. 18B** is a partially enlarged view of **FIG. 18A**;

[0062] **FIG. 18C** is a partial schematic view of **FIG. 18A**;

[0063] **FIGS. 19A through 19D** are views of a process to mount the toilet paper rolls of the seventh through ninth embodiments of the present invention on a thick shaft of a toilet paper roll holder by returning the toilet paper roll to its original circular shape;

[0064] **FIG. 20A** is a simplified plan view showing the final stage of the manufacturing process for the toilet paper roll of the seventh to ninth embodiments in a third manufacturing method of the present invention;

[0065] **FIG. 20B** is a plan view showing the main components of **FIG. 20A**;

[0066] **FIGS. 21A through 21F** are views showing the process for working the toilet paper roll of the seventh to ninth embodiments into a flat ellipse in the third manufacturing method of the present invention;

[0067] **FIGS. 22A through 22E** are views showing the process for working the toilet paper roll of the seventh to ninth embodiments into a flat ellipse in the third manufacturing method of the present invention;

[0068] **FIG. 23** is a perspective view of the main components used in manufacturing the toilet paper roll of the seventh to ninth embodiments in the third manufacturing method of the present invention;

[0069] **FIG. 24A** is a front view of the main components used in manufacturing the toilet paper roll of the seventh to ninth embodiments in a fourth manufacturing method of the present invention;

[0070] **FIG. 24B** is a view showing the manufacturing method of **FIG. 24A**;

[0071] **FIG. 25A** is a table of the rate of change under load categorized by winding type;

[0072] **FIG. 25B** is a simplified view of a measurement method for measuring the rate of change under load;

[0073] **FIG. 25C** is a graph comparing the rates of change under load categorized by winding type;

[0074] **FIG. 26** is a table of the measurement data for the rate of change under load of the product implemented in the present invention;

[0075] **FIG. 27** is a table of the measurement data for the rate of change under load of a slightly loose toilet paper roll;

[0076] **FIG. 28** is a table of the measurement data for the rate of change under load of another slightly loose toilet paper roll;

[0077] **FIG. 29** is a table of the measurement data for the rate of change under load of a toilet paper roll of regular tightness;

[0078] **FIG. 30** is a table of the measurement data for the rate of change under load of a slightly tight toilet paper roll;

[0079] **FIG. 31** is a table of the measurement data for the rate of change under load of a tight toilet paper roll;

[0080] **FIG. 32** is a table comparing measurements for toilet paper roll unwinding noise;

[0081] **FIG. 33** is a graph comparing measurements for toilet paper roll unwinding noise;

[0082] **FIG. 34** is a table comparing familiar noises and noise levels;

[0083] **FIG. 35** is a line diagram of the compressive load displacements of paper tubes of toilet paper rolls, comparing the product implemented in the present invention and a conventional product;

[0084] **FIG. 36** is a line diagram of the compressive load displacements during the manufacture of flat elliptical toilet paper rolls, comparing the product implemented in the present invention and a conventional product;

[0085] **FIG. 37** is a view showing a compressive load displacement experiment performed during manufacture of the toilet paper roll of the present invention;

[0086] **FIG. 38A** is a view showing a single unit of the product of the present invention in a wrapped state;

[0087] **FIG. 38B** is a view showing the products of the present invention wrapped in parallel;

[0088] **FIG. 39** is a view showing a compressive load displacement experiment performed during manufacture of the toilet paper roll of the present invention;

[0089] **FIG. 40A** is a view showing a single unit of the product of the present invention in a wrapped state;

[0090] **FIG. 40B** is a view showing the products of the present invention wrapped in parallel;

[0091] **FIG. 41A** is a perspective view of a toilet paper roll carton holding six of the toilet paper rolls of the present invention in a wrapped state;

[0092] **FIG. 41B** is a lateral cross section of **FIG. 41A**;

[0093] **FIG. 41C** is a lateral cross section of a different embodiment to that in **FIG. 41B**;

[0094] **FIG. 42A** is a perspective view of a toilet paper roll carton holding six conventional toilet paper rolls in a wrapped state;

[0095] **FIG. 42B** is a lateral cross section of **FIG. 42A**;

[0096] **FIGS. 43A through 43D** are views showing [a process in which] a conventional flat toilet paper roll is returned to its original state;

[0097] **FIG. 44A** shows a state in which a compressive load displacement experiment is about to begin during the manufacture of a conventional toilet paper roll;

[0098] **FIG. 44B** shows the locations of the compression points of yield during the experiment of **FIG. 44A**; and

[0099] **FIG. 44C** shows the final stage of the experiment of **FIG. 44A**.

BEST MODE FOR CARRYING OUT THE INVENTION

[0100] The present invention will be described below with reference to the drawings.

[0101] In a first embodiment, as is illustrated in **FIGS. 1 and 2**, a toilet paper roll is constituted by a thick tubular core **1** which is made of thin paper and has a diameter of approximately 4 cm, and toilet paper **2** which is wound around the thick tubular core **1** substantially loosely from beginning to end. The thickness of the thick tubular core **1** in **FIGS. 1A, 1C** and **2A** is thicker than the thickness of the toilet paper **2**, but the thick tubular core **1** is manufactured from thin paper and consequently is expressed in the drawings only by a line. This applies similarly to the second through ninth embodiments hereinbelow. **FIG. 1B** in particular shows that the paper thickness of the thick tubular core **1** is thicker than the paper thickness of the toilet paper **2**. The aforementioned toilet paper roll indicates a finished product in which the toilet paper **2** is formed into a roll. The aforementioned toilet paper **2** indicates paper of appropriate length and includes paper in either a rolled or unrolled form. As is illustrated in **FIG. 1A**, the toilet paper roll as a finished product may be sold in a state in which a circular cross section is maintained, or, due to the looseness of the entire product, may be sold in a flat elliptical form, as is illustrated by the dot/dash line in **FIG. 1C**. **FIG. 2C** is a schematic view of one part of **FIG. 2A**, and illustrates the entire height $H_0$of the wound toilet paper **2** (subject to no load) when wound substantially loosely. In other words, gaps occur between the layers of wound toilet paper **2**.

[0102] The thick tubular core **1** is manufactured from thin paper and has an inner diameter of approximately 4 cm (specifically a diameter of approximately 3.8 cm to approximately 4.5 cm), and is manufactured by overlapping a plurality of thin paper sheets, generally of approximately 30 (g/m^2) (weight in grams per 1 m^2 of paper) through 100 (g/m^2), twisting these sheets into a spiral form, and joining the sheets using an adhesive. In so doing, the weight of the regular paper alone cannot be measured, and therefore the weight of the thick tubular core **1** with an inner diameter of approximately 4 cm is measured in widths of one toilet paper roll (approximately 11 cm). According to this measurement, the weight of the thick tubular core **1**, including the weight of glue and the like, was between approximately 1 (g/roll) and 3 (g/roll). The material for the thin paper of the thick tubular core **1** includes both water-soluble percolation paper and non-percolation paper that is unlikely to dissolve in water, or water-soluble percolation paper only. Thus, when no limitations are placed on the material for the thick tubular core **1**, percolation paper and non-percolation paper are referred to. The aforementioned toilet paper **2** is percolation paper generally weighing from approximately 16 (g/m^2) to approximately 23 (g/m^2). In the aforementioned inner diameter of approximately 4 cm, diameters from approximately 3 cm up to 5 cm are included. The material for the thick tubular core **1** typically differs from the material for the toilet paper **2**. Here, the thick tubular core **1** is manufactured from thin paper. Although paper of approximately 70 (g/m^2) to 100 (g/m^2) does not generally lie within the concept of thin paper, in this specification particularly, the thick tubular core **1** uses woodfree paper with a general weight of approximately 30 (g/m^2) to 100 (g/m^2), as opposed to the cardboard used as the material for marketed paper tube cores, which generally weighs from approximately 200 (g/m^2) to approximately 220 (g/m^2), and is therefore referred to as being manufactured from thin paper. The toilet paper roll of a second embodiment, as illustrated in **FIG. 3**, is one in which toilet paper **2** is initially wound tightly around a thick tubular core **1** made of thin paper and with a diameter of around 4 cm, and thereafter wound loosely to the end, thus being substantially loosely wound as a whole. "Substantially loosely wound as a whole" is equivalent to the previously mentioned "wound substantially loosely from beginning to end", and cases to be mentioned hereinbelow are similar. **FIG. 3C** is a partial schematic diagram of **FIG. 3A**, and illustrates a tightly wound region H_2 and a substantially loosely wound region H_3 within the entire height $H_0$of the wound toilet paper **2** (when subject to no load). Hence, $H_2+H_3=H_0$.

[0103] The toilet paper roll in a third embodiment is comprised by toilet paper **2**, one part of which, excluding the initial part, is wound tightly around a thick tubular core **1** made of thick paper and with a diameter of around 4 cm, and the remainder thereof is wound substantially loosely, thus being wound substantially loosely as a whole. Specifically, as is illustrated in **FIG. 4**, this is a case in which the final few turns are wound tightly but the turns in all the other positions are wound substantially loosely. This type of winding is also indicated by "wound substantially loosely as a whole". Further, although not shown in the drawing, several turns may be wound tightly in an intermediate position in the toilet paper roll and the turns in all of the other positions wound substantially loosely. This also qualifies as "being wound substantially loosely as a whole". **FIG. 4C** is a partial schematic diagram of **FIG. 4A** in which a tightly wound region H_4 and a substantially loosely wound region H_5 are illustrated within the entire height H_0 of the wound toilet paper **2** (when subject to no load). Hence, $H_4+H_5=H_0$.

[0104] Further, in a fourth embodiment, as is illustrated in **FIGS. 10 and 11**, the toilet paper roll is constituted by a thick tubular core **1** manufactured from thin paper and having a diameter of approximately 4 cm, and toilet paper **2** which is wound substantially loosely around the thick tubular core **1** from beginning to end. As is shown in **FIG. 10**C, the thick tubular core **1** is formed into a flat shape, and the toilet paper **2** is also formed in a flat elliptical shape in compliance with the flat thick tubular core **1**. The toilet paper roll as a finished product is illustrated in **FIG. 10C**. **FIG. 10A** shows a semi-manufactured product directly after the toilet paper **2** has been wound around the thick tubular core **1**. Further, in the fourth through ninth embodiments of this specification, referring simply to the thick tubular core **1** indicates both the circular form (see **FIG. 10A**) and the flat form (seethe unbroken line in **FIG. 10C**). Moreover, referring simply to the toilet paper **2** indicates paper of appropriate length and includes paper in either a rolled or unrolled form.

[0105] In a fifth embodiment, as is illustrated in **FIG. 12**, the toilet paper roll is formed such that toilet paper **2** is initially wound tightly around a thick tubular core **1** made of thin paper and with a diameter of around 4 cm, and thereafter wound substantially loosely so as to be wound substantially loosely as a whole. The thick tubular core **1** is formed into a flat shape, and the toilet paper **2** is also formed into a flat elliptical shape in compliance with the elliptical thick tubular core **1**. **FIG. 12C** is a partial schematic diagram of **FIG. 12A**. In **FIG. 12**, the entire height H_0 (when subject to no load), the region H_2 and the region H_3 are similar to those in **FIG. 3**. The unbroken line in **FIG. 12A** indicates a semi-manufactured toilet paper roll, and the dot/dash line therein indicates the toilet paper roll as a finished product.

[0106] The toilet paper roll in a sixth embodiment, as illustrated in **FIG. 13**, is formed such that one part of the toilet paper **2**, excluding the initial part, is wound tightly around a thick tubular core **1** made of thin paper and with a diameter of around 4 cm, and the remainder thereof is wound substantially loosely around the thick tubular core **1**, thus being wound substantially loosely as a whole. The thick tubular core **1** is formed into a flat shape, and the toilet paper **2** is also formed into a flat elliptical shape in compliance with the flat thick tubular core **1**. Specifically, as shown in **FIG. 13**, the final few turns may be wound tightly, with the turns in all of the other positions wound substantially loosely. In **FIG. 13**, the entire height H_0 (when subject to no load), the region H_4 and the region H_5 are similar to those of **FIG. 4**. In **FIG. 13A** also, the unbroken line indicates a semi-manufactured toilet paper roll, and the dot/dash line therein indicates the toilet paper roll as a finished product.

[0107] In order to manufacture the toilet paper roll of the fourth to sixth embodiments, the two following types of manufacturing method are employed. In a first manufacturing method, the thick tubular core **1** is initially inserted into a roller shaft in perfect circle form. In this state, the toilet paper **2** is wound substantially loosely around the thick tubular core **1** from beginning to end, upon completion of which a semi-manufactured toilet paper roll aggregate body (i.e. between 10 and 20 semi-manufactured toilet paper rolls joined together with a circular cross section) is produced. Next, the roller shaft is removed from the semi-manufactured toilet paper roll aggregate body. In the following process, the top and bottom (see unbroken line in **FIG. 1A**) or both sides of the cross section of the semi-manufactured toilet paper roll are pushed inward to form the cross section of the thick tubular core **1** into a flat shape, and also to form the toilet paper **2** into a flat elliptical shape in compliance with the flat thick tubular core **1** (see dot/dash line in **FIG. 11A**).

[0108] In a second manufacturing method, pressure is applied to the entire cross section of the toilet paper roll of the fourth through sixth embodiments so as to form the roll into a flat elliptical shape. However, this may be achieved with only slight pressure, and therefore there are cases in which this process is performed on a semi-manufactured toilet paper roll and cases in which the toilet paper roll as a finished product is formed into a flat elliptical shape by pushing in both sides with guides on both sides which are used in the wrapping process.

[0109] The toilet paper roll in a seventh embodiment, as is illustrated in **FIGS. 15 and 16**, is constituted by a thick tubular core **1** which is manufactured from thin paper and has a diameter of approximately 4 cm, and toilet paper **2** which is wound substantially loosely around the thick tubular core **1** from beginning to end. As is shown in **FIG. 15**C, the thick tubular core **1** is formed into a substantially flat shape having expanded portions **1***a*, **1***a* on both sides thereof in the form of a sycamore seed, and the toilet paper **2** is also formed into a flat elliptical shape in compliance with the flat thick tubular core **1**. The toilet paper roll as a finished product is shown in **FIG. 15C**. **FIG. 15A** shows the semi-manufactured product directly after the toilet paper **2** has been wound onto the thick tubular core **1**. The gaps that are produced between the layers of wound toilet paper **2** are as in the first embodiment.

[0110] The toilet paper roll in an eighth embodiment, as is illustrated in **FIG. 17**, is formed such that toilet paper **2** is initially wound tightly around a thick tubular core **1** made of thin paper and with a diameter of around 4 cm, and thereafter wound substantially loosely so as to be wound substantially loosely as a whole. The thick tubular core **1** is formed into a substantially flat shape having expanded portions **1***a*, **1***a* on both sides thereof in the form of a sycamore seed, and the toilet paper **2** is also formed into a flat elliptical shape in compliance with the flat thick tubular core **1**. **FIG. 17C** is a partial schematic diagram of **FIG. 17**A, and the entire height H_0 (when subject to no load), the region H_2 and the region H_3 in **FIG. 17** are similar to those in **FIG. 3**. The unbroken line in **FIG. 17A** indicates a semi-manufactured toilet paper roll, whereas the dot/dash line therein indicates the toilet paper roll as a finished product.

[0111] The toilet paper roll in a ninth embodiment, as is illustrated in **FIG. 18**, is formed such that one part [of the toilet paper **2**], excluding the initial part, is wound tightly around a thick tubular core **1** made of thin paper and with a diameter of around 4 cm, and the remainder thereof is wound substantially loosely around the thick tubular core **1**, thus being wound substantially loosely as a whole. The thick tubular core **1** is formed into a substantially flat shape having expanded portions **1***a*, **1***a* on both sides thereof in the form of a sycamore seed, and the toilet paper **2** is also formed into a flat elliptical shape in compliance with the flat thick tubular core **1**. More specifically, as shown in **FIG. 18**, the final few turns are wound tightly, and the turns in all of the other positions are wound substantially loosely. The entire height

H_0 (when subject to no load), the region H_4 and the region H_5 in **FIG. 18** are similar to those in **FIG. 4**. The unbroken line in **FIG. 13A** also indicates a semi-manufactured toilet paper roll, whereas the dot/dash line indicates the toilet paper roll as a finished product.

[0112] In order to manufacture the toilet paper roll of the seventh to ninth embodiments, the following two types of manufacturing method are employed. A third manufacturing method uses a flattening device M shown in **FIG. 20**. This flattening device M is for positioning the semi-manufactured toilet paper rolls after the semi-manufactured toilet paper roll aggregate body has been cut into individual toilet paper rolls by a cutter N. To explain this manufacturing method specifically, as shown in **FIGS. 21 through 23**, the circular semi-manufactured toilet paper rolls are transported onto the flattening device M, and in this position a conveyor **25** stops (see **FIG. 21A**). Simultaneously, two hole-widening round bars **30, 30** which are clamped by front side position clamp portions **31, 31**, are inserted into the thick tubular core **1** of the semi-manufactured toilet paper roll (see **FIG. 21B**). Next, the hole-widening round bars **30, 30** are clamped at the rear end side thereof by rear side position clamp portions **31, 31** (see **FIGS. 21C and 21D**). In this state, the upper hole-widening round bar **30** is raised (see **FIGS. 21E and 21F**) such that the shape of the hole in the thick tubular core **1** is altered to a vertical flat ellipse (see **FIG. 22A**). In this state, the semi-manufactured toilet paper roll is pressed inward from the left and right by pressing portions **33, 33** on the ends of rods **32***a*, **32***a* of hydraulic cylinders **32, 32** (predominantly pneumatic cylinders) (see **FIGS. 22B and 23**), thereby forming fig-like expanded portions **1***a*, **1***a* on both sides (in **FIG. 22** on the top and bottom) of the thick tubular core **1**. Hence, the entire thick tubular core **1** is formed into a substantially flat shape, and the toilet paper **2** also takes on a flat elliptical shape in compliance with the flat thick tubular core **1**, thus completing the molding [process].

[0113] The front side position clamp portions **31, 31** are then removed, and at the same time the toilet paper roll finished product is transported on the now moving conveyor **25** to the wrapping machine C side (see **FIG. 22C**). Next, the two hole-widening round bars **30, 30** which are clamped by the rear side position clamp portions **31, 31** make a reverse turn such that the rear side position clamp portions **31, 31** become front side position clamp portions **31, 31** (see **FIG. 22D**). The upper hole-widening round bar **30** is lowered to return to its original position (see **FIG. 22E**), whereby, returning to **FIG. 21**A, the next semi-manufactured toilet paper roll undergoes flattening. During transportation of the toilet paper roll finished product, the shape of the flattened toilet paper roll is maintained by a curved guide **26** and a straight guide. **27** (see **FIG. 20B**). At the front and rear of the flattening machine M, the toilet paper roll is transported along a conveyor **23** and supported by straight guides **24, 24** on both sides.

[0114] In order to manufacture the toilet paper roll of the seventh to ninth embodiments using a fourth manufacturing method, a flattening device X in **FIG. 24** is used instead of the flattening device M. Specifically, the flattening device X is provided with upper and lower pressing support plates **40, 40** and left and right-side hydraulic cylinders **41, 41** (predominantly pneumatic cylinders) (see **FIG. 24A**). In this operation, [the semi-manufactured toilet paper roll] is pressed inward by pressing portions **42, 42** on the ends of rods **41***a*, **41***a* of the hydraulic cylinders **41, 41**, simultaneously being supported by the upper and lower pressing support plates **40, 40** (see **FIG. 24B**). Thereby, sycamore seed-type expanded portions **1***a*, **1***a* are formed in the upper and lower positions of the flattened thick tubular core **1**, and hence the entire thick tubular core **1** is formed into a substantially flat shape, and the toilet paper **2** also takes on a flat elliptical shape in compliance with the flat thick tubular core **1**, thus completing the molding [process].

[0115] The above product of the present invention is used when mounted on a thick shaft portion **10** of a toilet paper roll holder. The aforementioned "wound substantially loosely from beginning to end" and "wound substantially loosely as a whole" indicate that the amount of air gaps between the layers of toilet paper **2** has been increased. As a result of this increase in the amount of air gaps, when toilet paper which is mounted on the thick shaft portion **10** of the toilet paper roll holder is pulled, the toilet paper roll rotates such that the thick tubular core **1** and the thick shaft portion **10** of the toilet paper roll holder contact each other irregularly, whereby the toilet paper roll generates an unwinding noise. Nevertheless, the toilet paper **2** which is "wound substantially loosely from beginning to end" or "wound substantially loosely as a whole" exists around the thick tubular core **1**, and thus, by means of the air gaps between the layers of toilet paper, this noise is eliminated or reduced without reaching the outside (see the S portion in **FIG. 5**A and **FIG. 5B**). Furthermore, since the thick tubular core **1** is made of thin paper and the toilet paper **2** that is "wound substantially loosely from beginning to end" or "wound substantially loosely as a whole" exists on the thick tubular core **1**, one location on the thick tubular core **1** of the toilet paper roll becomes flattened when the toilet paper **2** is unrolled (pulled) (see **FIG. 5A**). Further, at this point in time, the thick tubular core **1** and the thick shaft portion **10** are in close contact at a shaft side point P_{C2} and a tube side point P_{O2}, whereas no contact is made at a shaft side point P_{C1} and a tube side point P_{O1}, as is illustrated in **FIG. 6A**. In the next moment, contact continues to be made at the shaft side point P_{C2} and tube side point P_{O2}, while contact is also made at the shaft side point P_{C1} and tube side point P_{O1}. Thus, during rotation, contact is made as a surface. In this manner, surface contact is made due to the looseness [of the toilet paper roll], whereby either no noise or an extremely soft sound is produced. On the other hand, as is illustrated in **FIG. 7**, in a cardboard tube core a of a conventional toilet paper roll, at one moment there are points which contact the thick shaft portion **10**, and a shaft side point P_c and a tube side point P_O which do not make contact. At the next moment, however, the shaft side point P_C and tube side point P_O contact each other but the points that were previously in contact separate from each other. Thus, during rotation, contact is made at points, and in this state of point contact a large unwinding noise is generated in the toilet paper roll. The product of the present invention solves such a disadvantage by the surface contact action shown in **FIG. 6**.

[0116] As described above, the product of the present invention is able to drastically reduce unwinding noise in a toilet paper roll because the increase in the amount of air gaps between the layers of the toilet paper **2** and the surface contact of the loose surfaces act synergistically.

[0117] Further, as shown in **FIG. 9**, the percolation paper that is the material of the thick tubular core **1** has a water-soluble property, and thus softens when holding water, thereby altering the form of the thick tubular core **1**. Hence, a toilet can be prevented from blocking even when the thick tubular core **1** which remains on the thick shaft portion **10** of a typical household toilet paper roll holder following use of a toilet paper roll is flushed down the toilet.

[0118] Also, as is illustrated in **FIG. 14A**, the thick tubular core **1** of the product of the present invention is formed into a flat shape, and the toilet paper **2** is formed into a flat elliptical shape in compliance with the flat thick tubular core. Nevertheless, when mounted on the thick shaft portion **10** of a toilet paper roll holder, the toilet paper roll can be returned to a substantially perfect circle form. As is illustrated in **FIGS. 14A through 14D**, since the thick tubular core **1** is made of thin paper and the toilet paper is "wound substantially loosely from beginning to end" or "wound substantially loosely as a whole", the toilet paper roll can be returned to a substantially perfect circle form due to the synergistic action between the loose toilet paper **2** and the fact that almost no pressure [need be] applied even when the thick tubular core **1** is flattened since the thick tubular core **1** is made of thin paper. Furthermore, even though the thick tubular core **1** is formed into a substantially flat shape having fig-like expanded portions **1***a*, **1***a* on both sides, and the toilet paper **2** is formed into a flat elliptical shape in compliance with the flat thick tubular core **1**, the expanded portions **1***a*, **1***a* on both sides create no kinks whatsoever in the thick tubular core **1** upon mounting onto the thick shaft portion **10** of the toilet paper roll holder, and thus, the thick tubular core **1** can be returned to a substantially perfect circular form.

[0119] **FIG. 41A** shows six of the toilet paper rolls of the present invention sealed in one carton. **FIG. 41B** shows the state of insertion of the toilet paper rolls in a lateral cross section of the carton. **FIG. 41C** shows a cross section of the toilet paper roll carton in a case in which the thick tubular core **1** is formed into a substantially flat shape having fig-like expanded portions **1***a*, **1***a* on both sides. If the conventional type toilet paper roll cartons of **FIGS. 42A and B** are compared with the toilet paper roll carton of the present invention in **FIG. 41**, it can be seen as a result of experiment that the surface area of the lateral cross section of the product of the present invention is approximately 30% to 40% smaller than that of the conventional product.

Experiment 1

[0120] In this specification, "wound substantially loosely" indicates that when a 13 kg load measuring weight **21** is applied to a toilet paper roll, the rate of change under load thereof is approximately 36% or greater. This is according to the following experiment.

$$\text{Rate of change under load} = (H_0 - H_1)/H_0 \times 100$$

[0121] H_0: height when subject to no load

[0122] H_1: height when a 13 kg load measuring weight **21** is applied

[0123] In the experiment, as is shown in **FIG. 25B, a** measuring shaft **20** was inserted into the thick tubular core **1** of the toilet paper roll manufactured according to the present invention, the paper tube core of a marketed toilet paper roll, or a toilet paper roll core, the height of the uppermost position on the periphery of the thick tubular core **1** etc. was set to 0, this was set as the reference height position, and the height therefrom to the uppermost end position on the periphery of the toilet paper **2** of the toilet paper roll with no load thereupon, or in other words the height of the toilet paper roll when subject to no load, was set as H_0. A 13 kg measuring weight **21** was placed upon the toilet paper roll subject to no load, and at that time, the gaps between the layers of toilet paper **2** became narrower due to the measuring weight **21**, thereby reducing the height. The height to the uppermost end position on the periphery of the toilet paper **2** at this time, or in other words the height upon application of a 13 kg load, was set as H_1.

[0124] In the experiment, the following were used for rate of change under load measurement data: the product of the present invention (see **FIG. 26**); loosely wound with core A (see **FIG. 27**) and loosely wound with core B (see **FIG. 28**), which were chosen appropriately with texture as a reference and are wound slightly loosely at their center; normally wound with core (see **FIG. 29**) in which the surface turns are wound at a normal level of tightness; tightly wound with core (see **FIG. 30**) which is wound slightly tightly; and tightly wound no core (see **FIG. 31**) which is wound tightly. The H_0 and H_1 of this plurality of samples were measured. The resulting measurement data are shown in **FIGS. 26 through 31**, and the maximum rate of change under load, average rate of change, and minimum rate of change are gathered and shown in **FIG. 25A**. When made into a comparison graph, such as **FIG. 25**C, the following can be observed.

[0125] That is, "tightly wound" indicates a rate of change under load of 0% to approximately 9%; "slightly tightly wound" indicates a rate of change under load of approximately 9% to approximately 21%; "wound to a normal level of tightness" indicates a rate of change under load of approximately 21% to approximately 36%; "slightly loosely wound" indicates a rate of change under load of approximately 36% to approximately 49%; and "loosely wound" indicates a rate of change under load of approximately 49% or greater. Thus, since "substantially loosely wound" includes "loosely wound" and "slightly loosely wound", the previously mentioned "substantially loosely wound" indicates that under a load of 13 kg, the rate of change under load is approximately 36% or greater. This value may vary by approximately 10% depending on the temperature, humidity, air pressure and so on in the placement condition of the toilet paper roll.

[0126] Further, the (H_0-H_1) of the previous equation also expresses the amount of air gaps between the layers of the toilet paper **2** in the toilet paper roll, and therefore the rate of change under load according to this equation can be said to be substantially equal to the air gap ratio. Accordingly, an air gap ratio of approximately 36% or greater can be said to be "wound substantially loosely". It is important to note here that the surface load is 13 kg. With an 18 kg measuring weight **21**, the value of (H_0-H_1) increases such that the rate of change under load increases for all of the categories of winding method. Thereby, a rate of change under load of approximately 40% or greater indicates "wound substantially loosely". With a 7 kg measuring weight **21**, for example, the value of (H_0-H_1) decreases such that the rate of change under load decreases for all of the categories of

winding method. Thereby, a rate of change under load of approximately 30% or more indicates "wound substantially loosely".

Experiment 2

[0127] In an experiment shown in **FIG. 32** to measure the unwinding noise of the toilet paper roll of the present invention, the toilet paper roll of the present invention was compared with a conventional toilet paper roll with a typical cardboard paper tube core, whereby it was learned that the toilet paper roll of the present invention becomes progressively quieter. To described the experiment specifically, the thick tubular core **1** relating to the present invention is made from thin paper, has an inner diameter of approximately 3.8 cm, and weighs approximately 1.6 g per length of toilet paper roll (approximately 11 cm). The thick tubular core **1** is formed from two thin paper sheets of approximately 50 (g/m^2) which are appropriately twisted into spiral form and overlapped. Water-soluble percolation paper is used as the material for the thin paper of the thick tubular core **1**. As the conventional product, a so-called normally wound with core toilet paper roll was used, wound at a normal level of tightness onto a cardboard paper tube core with an inner diameter of approximately 3.8 cm. Both the toilet paper roll of the present invention, manufactured with toilet paper **2** which is "loosely wound" and the conventional normally wound with core toilet paper roll were set with outer diameters of approximately 110 mm. The toilet paper rolls were mounted onto the thick shaft portion **10** of a typical household one touch-type toilet paper roll holder, the lid of the toilet paper roll holder was removed so as to eliminate contact noise between the lid and the toilet paper, and the unwinding noise generated when pulling the toilet paper was measured. Measurement was performed with a sound sensor disposed at approximately 50 cm, 1 m, and 1.5 m from the location of the toilet paper roll holder. Even if the unwinding rate of the toilet paper is constant, the toilet paper roll is unwound from the outer periphery side, and therefore the rate is slow at the peripheral portion which has a large outer diameter, and the rate increases as the diameter grows smaller toward the central portion. Consequently, measurement was performed at three locations, the peripheral portion, an intermediate portion, and the central portion (at the thick tubular core side).

[0128] As is shown in the table in **FIG. 32**, the unwinding noise grew quieter by between 12 dB (decibels) and 17 dB in all of the peripheral portion, intermediate portion, and central portion (at the thick tubular core side) positions. In a toilet or the like, it is normal for another person to be removed by at least 1 m, and hence, taking an average of the two samples, [the noise level of] the conventional normally wound with core-type was 65 dB, and the product of the present invention was 53 dB. Although the difference is only 12 dB, decibels express sound levels as logarithms, and hence a difference of 10 dB corresponds to a sound level that is 10 times higher. In other words, the progressive differences are as follows: a difference of 12 dB corresponds to a sound level that is approximately 16 times higher; 13 dB corresponds to approximately 20 times higher; 14 dB corresponds to approximately 25 times higher; 15 dB corresponds to approximately **32** times higher; **16**dB corresponds to approximately 40 times higher; and 17 dB corresponds to approximately 50 times higher. Expressing the table in **FIG. 32** as a graph results in **FIG. 33**, wherein the differences in unwinding noise between the conventional product and the product of the present invention become obvious. By referencing a comparative table of familiar noises and noise levels, as in **FIG. 34**, it can be seen that approximately 65 dB is in an intermediate position between a regular conversation and the sound of a noisy office or a telephone, whereas the approximately 53 dB of the product of the present invention is a sound close to a quiet office. Therefore, simply considering the level of noise, the difference is extremely striking. Thus, when the product of the present invention is used, the unwinding sound of the toilet paper roll becomes extremely small, and hence the toilet paper roll can be used freely, even by women, without anxiety.

Experiment 3

[0129] **FIG. 35** is a line diagram of the compressive load displacements of paper tubes of toilet paper rolls (paper tube cores, the thick tubular core **1** of the present invention and so on). The thick tubular core **1** of the present invention has an inner diameter of approximately 3.8 cm, and thick tubular cores **1** with weights per one length of toilet paper roll (approximately 11 cm) of 1.0 (g/roll), 1.6 (g/roll), 2.0 (g/roll), 2.4 (g/roll) and 3.0 (g/roll) were used. Conventional cardboard paper tube cores of 5.9 (g/roll) and 6.4 (g/roll) were also used. Water-soluble percolation paper was used as the material for the thin paper of the thick tubular core **1**. The aforementioned 1.0 (g/roll), 1.6 (g/roll), 2.0 (g/roll), 2.4 (g/roll) and 3.0 (g/roll) thick tubular cores **1** are formed by two sheets of thin paper with respective weights of approximately 30 (g/m^2), approximately 50 (g/m^2), approximately 65 (g/m^2), approximately 80 (g/m^2), and approximately 100 (g/m^2), twisted appropriately into spiral form and overlapped. Further, the conventional cardboard paper tube cores of 5.9 (g/roll) and 6.4 (g/roll) are formed by two sheets of thick paper respectively weighing approximately 200 (g/m^2) and approximately 220 (g/m^2), twisted appropriately into spiral form and overlapped. In this experiment, a load was applied to the thick tubular core **1** and the paper tube core, having an inner diameter of approximately 3.8 cm, so as to cause height variations from 0 to 15 mm, and thus a line diagram of the compressive load displacements of the paper tubes of toilet paper rolls was determined.

[0130] As is shown in **FIG. 35**, the results thereof indicate that the 2.0 (g/roll) thick tubular core **1** of the present invention can be pressed inward with up to one twentieth of the force (N) required for the 6.4 (g/roll) conventional cardboard paper tube core. Thus, as noted previously, the thick tubular core **1** can be crushed easily and with far less force than that required by a conventional cardboard paper tube core (see **FIG. 8**). It can also be understood from **FIG. 35** that woodfree paper of up to approximately 3 (g/roll) is appropriate for the thin paper used to manufacture the thick tubular core **1** of the present invention. Further, the weight of the thick tubular core **1** varies by approximately 10% to **20**% according to the amount of glue, and therefore woodfree paper of up to approximately 4 (g/roll) may also be included in the thin paper used to manufacture the thick tubular core **1** of the present invention.

Experiment 4

[0131] **FIG. 36** is a line diagram of toilet paper roll compressive load displacements upon the manufacture of the toilet paper rolls of the fourth through ninth embodi-

ments of the present invention in particular. The thick tubular core **1** of the present invention has an inner diameter of approximately 3.8 cm, and a weight per one length (approximately 11 cm) of toilet paper roll of 1.6 (g/roll). The toilet paper roll used is wound loosely and has an outer diameter of approximately 11 cm. A toilet paper roll with a cardboard paper tube core weighing 6.4 (g/roll), which is normally wound with a core and has an outer diameter of approximately 11 cm, is used as marketed product a, and a toilet paper roll with a cardboard paper tube core weighing 5.9 (g/roll), which is loosely wound with a core and has an outer diameter of approximately 11 cm, is used as marketed product b.

[**0132**] In the experiment, a compressive load was applied and the resulting displacement was measured. In this specification, there is a factor of error of approximately 2%, and 1 kgf is set as 10N (Newton). Hence, as is illustrated in **FIG. 36**, when a compressive load is gradually applied to the circular marketed product a, applying approximately 5N causes displacement of approximately 8 mm, and applying approximately 10N causes displacement of approximately 14 mm. Further, when the maximum compressive load of approximately 10.5N is applied, displacement of approximately 15 mm occurs (see **FIG. 44B**). Thereafter, the amount of displacement increases even when a compressive load which is no more than the maximum compressive load is applied. At the point when approximately 9.5N causes an approximately 50 mm displacement, the paper tube core becomes flattened and the toilet paper is formed into a flat elliptical shape (see **FIG. 44C**). Further, in circular marketed product b, application of approximately 6N causes displacement of 20 mm, and approximately 10.2N causes displacement of 30 mm. When the maximum compressive load of 10.5N is applied, displacement of 32 mm occurs (see **FIG. 44B**), after which the amount of displacement increases even when a compressive load which is no more than the maximum compressive load is applied. At the point when approximately 9.9N causes an approximately 60 mm displacement, the paper tube core becomes flattened and the toilet paper is formed into a flat elliptical shape (see **FIG. 44C**). Note that in a tensile test, the point at which the amount of displacement increases without increasing the tensile load is defined in JIS terminology as the "yield point". In the present invention, it is a compressive displacement experiment that is performed, but since the amount of displacement increases from the point of maximum compressive load without adding to the compressive load, this maximum compressive load point is referred to as the "compression yield point" in this specification. In this compressive displacement experiment, the height of the marketed product a and marketed product b prior to shape alteration is set as Y_0, and the height thereof following compression into a flat elliptical shape is set as Y_2 (see **FIG. 44**).

[**0133**] In the present invention, as is shown in **FIG. 36**, the circular semi-manufactured toilet paper roll is displaced by 18 mm when approximately 1N is applied, and by 30 mm when 2N are applied. When the maximum compressive load of approximately 4N is applied, the toilet paper roll changes shape by approximately 42 mm of displacement, and at this point the thick tubular core **1** becomes flattened and the toilet paper **2** is formed into a flat elliptical shape. In this compressive displacement experiment, when the height of the circular toilet paper roll of the present invention prior to displacement is set as Y_0, the height thereof following compression into a flat elliptical shape becomes Y_1, and no compression occurs beyond the aforementioned height Y_2. Hence, height Y_1>height Y_2 (see **FIGS. 37, 39** and **44**). Further, there is no compression yield point in the product of the present invention. In the marketed products a and b, the amount of displacement is large as a whole when moving from the state in **FIG. 44B** to that in **FIG. 44C**. In other words, during the pressure-flattening operation of the paper tube core in the compression process, a large amount of force is required at the point where the paper tube core takes a rhomboid elliptical shape due to the hardness of the cardboard paper tube core, and up to that point the upper and lower layers of toilet paper **2** are pressed together and compressed (see **FIG. 44B**). The maximum value at this point is a prescribed value, and the point of this prescribed value is referred to as compression yield point K (see **FIG. 36**). From the point of this compression yield point K, the amount of displacement increases even without increasing the pressure of the compressive load on the semi-manufactured toilet paper roll above the prescribed value (in the graph in **FIG. 36**, approximately 10N and 1.05 kgf). At this time, the paper tube core is flattened and the degree of flatness of the toilet paper increases further to form a flat elliptical shape.

[**0134**] As is illustrated in **FIGS. 38 and 40**, since only a small amount of pressure (compressive load) need be applied to flatten the thin paper thick tubular core **1** and form the loosely wound toilet paper **2** into a flat elliptical shape, the repulsive force f, f needed in order to return the toilet paper roll to its original circular form is also small, and packaging by sealing the product into a bag **50** can be performed easily. In the present invention, in the operation to form the toilet paper **2** into a flat elliptical shape, the applied pressure is merely up to 4N, and thus the toilet paper roll responds sufficiently well to the application of pressure in the packaging process. Manufacture can also be easily accomplished at approximately 5N.

[**0135**] According to the present invention as described above, the unwinding noise of a toilet paper roll can be reduced considerably. More specifically, even if the toilet paper roll of the present invention is mounted onto the thick shaft portion of a typical household toilet paper roll holder or the like such that the thick shaft portion and the thick tubular core contact one another while rotating to produce contact noise, squeaks or the like, this noise is eliminated or reduced without being transmitted to the outside due to the fact that the thick tubular core is made of thin paper and therefore rotates in compliance with the toilet paper roll holder so as to make surface contact therewith, and due to the fact that toilet paper that is "wound substantially loosely" exists around the thick tubular core and air gaps exist between the layers of the toilet paper. This fact was clearly proven in the experiment in **FIG. 32** and **33**. In this experiment, a reduction in unwinding noise of between approximately 12 dB and approximately 17 dB was achieved. In actuality, however, almost no noise could be heard. As a result, a silent-type toilet paper roll can be provided having the great advantage that unwinding noise such as rattling noise generated when using the toilet paper in a toilet can be eliminated, whereby women in particular can use the toilet paper without anxiety.

[0136] Furthermore, in the present invention, the thick tubular core is manufactured from thin paper, and therefore has far less strength than a conventional cardboard paper tube core. As a result, even women and children can easily crush the thick tubular core which remains on the thick shaft portion of a typical household toilet paper roll holder after use of the toilet paper roll (see **FIG. 8**). This has the advantages of enabling a reduction in household refuse and allowing the thick tubular core to be disposed of as general refuse. Moreover, since the thick tubular core is manufactured from thin paper, this paper is thinner than that of a conventional cardboard paper tube core, and the amount of paper used is lower. Thus, the unit price of the core itself can be reduced. As a result, the entire toilet paper roll can be produced at a comparatively reasonable price. Further, soft type core-less toilet paper rolls exist in one part of the market, but the glued sections of the core have a damaged appearance, making it difficult for such products to penetrate general markets. Alternatively, the machines for manufacturing these soft type core-less toilet paper rolls are special machines of a particular specification, meaning that such toilet paper roll is comparatively extremely expensive to produce. In the present invention, however, the outer appearance of the paper tube core is substantially identical in form to that of a typical paper tube core, and the production costs thereof can be progressively improved. Hence, in addition to the elimination of noise and favorability in respect of refuse disposal as described above, the price of a single unit of the product can be reduced.

[0137] Moreover, according to the present invention, since the thick tubular core is made of percolation paper and therefore has a water-soluble property, toilet blockages can be avoided even when the thick tubular core is flushed down the toilet after use. The toilet paper roll of the present invention also has a flat elliptical shape, and therefore, in comparison with a conventional toilet paper roll in perfect circle form, has the advantages of greatly reducing space such that storage costs, transport costs and so on can be reduced.

Industrial Applicability

[0138] The present invention may be used as a toilet paper roll in which unwinding noise is greatly reduced even upon mounting onto the thick shaft portion of a typical household toilet paper roll holder, in which the thick tubular core of the toilet paper roll can be easily crushed and disposed of and is therefore favorable as regards refuse processing, in which the thick tubular core can also be manufactured reasonably such that the manufacturing cost of the toilet paper roll can also be reduced in price, in which the thick tubular core can also be flushed into the toilet, in which moreover, since the toilet paper roll is manufactured into a flat elliptical form, storage costs, transport costs and the like can be reduced, and in which during use, the cross section becomes substantially circular such that the toilet paper roll is sufficiently usable.

1. A toilet paper roll characterized in comprising: a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm; and toilet paper which is wound substantially loosely from beginning to end around this thick tubular core.

2. A toilet paper roll characterized in comprising: a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm; and toilet paper which is wound around this thick tubular core tightly in the initial several turns and thereafter wound substantially loosely to the end, thereby being wound substantially loosely as a whole.

3. A toilet paper roll characterized in comprising: a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm; and toilet paper which is wound around this thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, thereby being wound substantially loosely as a whole.

4. The toilet paper roll according to claim 1, **2** or **3**, characterized in that said thick tubular core is manufactured from percolation paper.

5. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound substantially loosely from beginning to end around this thick tubular core, and characterized in that said thick tubular core is formed into a flat shape and said toilet paper is also formed into a flat elliptical shape in compliance with said flat thick tubular core.

6. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly in the initial several turns and thereafter wound substantially loosely to the end, thereby being wound substantially loosely as a whole, and characterized in that said thick tubular core is formed into a flat shape and said toilet paper is also formed into a flat elliptical shape in compliance with said flat thick tubular core.

7. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, thereby being wound substantially loosely as a whole, and characterized in that said thick tubular core is formed into a flat shape and said toilet paper is also formed into a flat elliptical shape in compliance with said flat thick tubular core.

8. The toilet paper roll according to claim 5, **6** or **7**, characterized in being formed such that during the formation of said toilet paper into a flat elliptical shape, there is no compression yield point at which, when a compressive load of a prescribed value is applied to a semi-manufactured toilet paper roll, the amount of displacement increases even without applying further pressure, and such that the amount of displacement only increases under pressure that increases gradually in the range of half or less the compressive load of said prescribed value.

9. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound substantially loosely around this thick tubular core from beginning to end, and characterized in that said thick tubular, core is formed into a substantially flat shape having fig-like expanded portions on both sides, and said toilet paper is also formed into a flat elliptical shape in compliance with said substantially flat thick tubular core.

10. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has

a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly in the initial several turns and thereafter wound substantially loosely to the end, thereby being wound substantially loosely as a whole, and characterized in that said thick tubular core is formed into a substantially flat shape having fig-like expanded portions on both sides, and said toilet paper is also formed into a flat elliptical shape in compliance with said substantially flat thick tubular core.

11. A toilet paper roll characterized in comprising a thick tubular core which is manufactured from thin paper and has a diameter of approximately 4 cm and toilet paper which is wound around this thick tubular core tightly for several turns at a part excluding the initial part and thereafter wound substantially loosely, thereby being wound substantially loosely as a whole, and characterized in that said thick tubular core is formed into a substantially flat shape having fig-like expanded portions on both sides, and said toilet paper is also formed into a flat elliptical shape in compliance with said substantially flat thick tubular core.

12. The toilet paper roll according to claim 9, **10** or **11**, characterized in being formed such that during the formation of said toilet paper into a flat elliptical shape, there is no compression yield point at which, when a compressive load of a prescribed value is applied to a semi-manufactured toilet paper roll, the amount of displacement increases even without applying further pressure, and such that the amount of displacement only increases under pressure that increases gradually in the range of half or less the compressive load of said prescribed value.

13. A manufacturing method for a toilet paper roll, characterized in comprising the steps of:

manufacturing a semi-manufactured toilet paper roll comprising a thick tubular core which is made of thin paper and which has a diameter of approximately 4 cm, and toilet paper which is wound substantially loosely as a whole around this thick tubular core;

fixing and supporting this semi-manufactured toilet paper roll in a substantially outer diametrical position with facing pressing support plates; and

pressing the semi-manufactured toilet paper roll inward at a substantially central position in the two substantially orthogonal directions to the direction of spacing between the two pressing support plates using pressing portions on the ends of hydraulic cylinders, whereby the thick tubular core is formed into a substantially flat shape as a whole while forming fig-like expanded portions on the two end positions of the substantially flat thick tubular core, and the toilet paper is also formed into a flat elliptical shape in compliance with said substantially flat thick tubular core.

14. A manufacturing method for a toilet paper roll, characterized in comprising the steps of:

manufacturing a semi-manufactured toilet paper roll comprising a thick tubular core which is made of thin paper and which has a diameter of approximately 4 cm, and toilet paper which is wound substantially loosely as a whole around this thick tubular core; and

stretching said thick tubular core by inserting two hole-widening round bars therein for forming said thick tubular core into a flat elliptical shape while pressing said thick tubular core inward from both sides using hydraulic cylinders in directions which are orthogonal to the spacing between said two hole-widening round bars while, whereby the thick tubular core is formed into a substantially flat shape as a whole while forming fig-like expanded portions on the two end positions of the substantially flat thick tubular core, and the toilet paper is also formed into a flat elliptical shape in compliance with said substantially flat thick tubular core.

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