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(54) Process and apparatus for the automatic folding of rectangular textile articles.

(57) A process and apparatus for the automatic sequential folding of napkins, towels, pillow cases, tablecloths and sheets after washing and ironing.

The folding apparatus comprises a horizontal conveyor (N1) with fixed guide means (5), an inclined conveyor (N2) with a retractable rake (R2), an inclined plane (S) with another retractable rake (R1) and a horizontal delivery conveyor (N3). Four rollers (1, 2, 3, 6) move and guide the article of linen. There are also provided two ducts (C1, C2) which push the fold between adjacent rollers (1, 2; 2, 3) by jets of compressed air.

The process and folding apparatus are characterized by the fact that they may be used for any article of linen, whatever its measurements, and for any desired type of fold.

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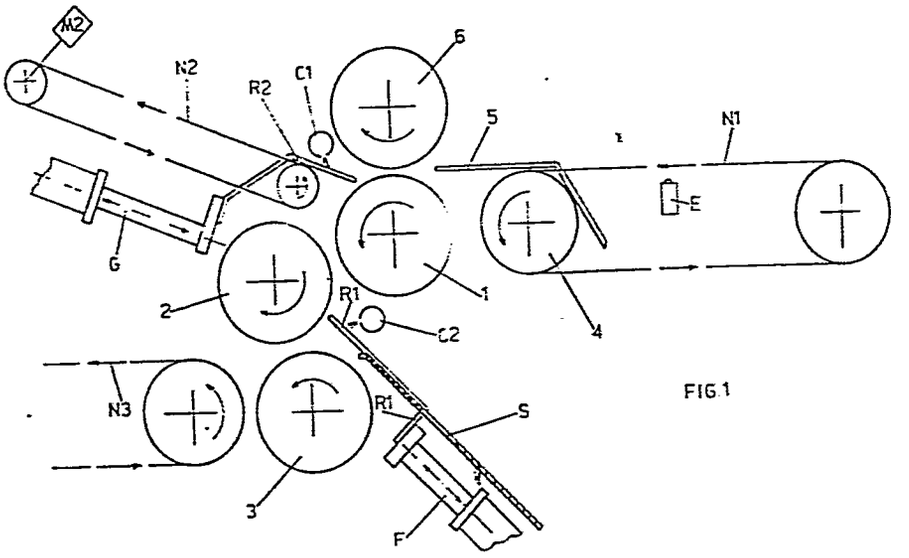


FIG.1

TITLE MODIFIED
see front page

Process with relative machine for the automatic foldin in sequence of napkins, towels, pillow cases, tablecloths, and sheets after they have been washed and ironed.

This application for industrial patent relates to a process with relative machine for the automatic folding in sequence of napkins, towels, pillow cases, tablecloths and sheets after they have been washed and ironed.

The automatic machines currently in use are only able to fold one type or several similar types of linen as, not only is there a great difference in size between one article of linen and another, but also, each article requires a particular fold.

For the sake of illustration and clarification a towel, for example, is usually folded lengthwise in three more or less equal parts and crosswise in two exactly equal parts, whilst a napkin is usually folded in three parts both lengthwise and crosswise.

As regards the folding processes commonly used, they are essentially based on the use of groups of conveyor belts along which are various stations where "knives" or "guillotines" descend and press into the linen, thus folding it.

In the case of smaller sized linen, for example, pillow cases, napkins or hand towels, the folding processes commonly used consist essentially of a table with moveable palettes or brackets along its edges, which are able, according to a preset sequence, to lift, turn over and fold articles of linen placed upon them.

The aim of this invention is to invent a new automatic folding process together with the relative machine able to be used for any article of linen, whatever its measurements, and for any desired type of fold.

A further aim of this invention is to invent a folding process which allows the machine to work at high speeds, thus giving a high hourly rate of production.

All this has been made possible thanks to our invention which folds the article of linen twice in rapid succession and always at the same station, in contrast with traditional machines where for each fold a different station (with "knife" or "guillotine") is necessary.

Furthermore, this new folding process, according to the instant invention, means that it has been possible to realize a far less cumbersome machine; a machine which in any case is more compact than present-day models.

The fully automatic folding of the aforementioned articles of linen takes place, according to this invention, at a station which essentially comprises a set of three straight rollers on a horizontal axis, adjacent to one another and positioned in such a way as to have two rollers side by side and two placed one above the other.

The ironed article of linen moves forward over the two adjacent rollers where a pressing mechanism is provided above and close to the two adjacent rollers in order to fold the article in the desired place.

Said rollers grip and pull the fold which has been made downwards, thus folding the article for the first time.

Another mechanism, situated immediately in front of the two rollers placed one above the other, and identical to the previous one, makes a second fold always in the desired place.

Said rollers grip and pull this second fold sideways, thus the article is folded a second time. It is then released onto a horizontal conveyor belt found immediately behind the two rollers placed one above the other.

Should for any reason the second fold not be required the second mechanism does not operate and the article of linen, on leaving the two adjacent rollers, automatically passes between the rollers placed one above the other.

The accompanying drawings are for a clearer illustration of the machine which carries out the folding process according to the herein described invention, but they exemplify only one preferred embodiment in a schematic form.

Fig. 1 schematically illustrates, in side view and in a direction parallel to the longitudinal axis of the rollers, the members present in the station.

Fig. 2 schematically illustrates, in side view, the supporto members of each roller found at the station, in accordance with the invention, as well as the drive system employed there.

Figures 3 and 4 are e schematic illustration in prospective of the machine in accordance with the invention, which for obvious reasons of space has been divided and set out in two different tables.

Figures 5 and 6 are a schematic top view of the machine, in accordance with the invention, which for obvious reasons of space have been divided and set out in two different tables.

With reference to figure 1, the folding of the linen takes place at a station which comprises a main group of three staight rollers on a horizontal axis, equal in diameter and indicated by the numbers (1), (2), and (3). Said rollers are close together and arranged in such a way that roller (1) and roller (2) are adjacent but slightly offset with respect to a horizontal plane, in that roller (2) in relation to the forward movement of the linen, comes after, and is slightly lower than roller (1).

On the other hand roller (2) and roller (3) are placed one above the other but slightly offset with respect to a vertical plane, in that roller (3), which is below roller (2), is laterally offset towards roller

(1).

Roller (1) lies immediately at the end of a convevor (N1) which moves forward horizontally and on which the ironed linen is placed for folding.

Number (5) indicates the flat tooth of a fixed "comb" which holds the article of linen in place on its way from the end of the convevor (N1) and the beginning of the roller (1).

Immediately umstream from the roller (1) and immediately above the roller (2) begins a second convevor (N2), which moves upwards.

Under the roller (1) is an inclined plane (S), the upper edge of which is close to the top and side of the roller (3).

The upper edge of this slide (S) is characterized by a plurality of U-shaped notches, regularly spaced, into which fit the flat teeth of a rake (R1), which may be pushed forward by a hydraulic ram (F) fixed under the slide (S).

The station also comprises two thin tubular ducts on a horizontal axis, perforated along a generating line and from which, at the appropriate moment, jets of compressed air are released:

- the first duct (C1) is placed immediately above the beginning of the convevor (N2), which is provided with its own driving mechanism (M2);

- the second tube (C2) is placed immediately above the upper edge of the slide (S), in front of the entry point between roller (2) and roller (3).

With reference to figure (2) the drive motion present at the herein described station shall be examined.

Number (7) indicates one of the two lateral support plates of the aforesaid rollers.

(P4) indicates the driving pulley of the roller (4) which moves the convevor (N1), a pulley which is connected to the main motor by a toothed belt (T). (in dotted lines).

(P1), (P2), (P3) and (P6) indicate the driving pulleys for rollers (1), (2), (3) and (6).

Pulley (P4) drives, by means of a toothed drive belt (T1) (in continuous line) roller (3), roller (2), and a roller (6), on a horizontal axis, exactly above roller (1).

Said roller (1) is also driven by the pulley (4), independently of the others, by means of its own toothed drive belt (T2) (indicated by lines and dots).

In the light of what has been described above and with reference to the illustrations, we shall now proceed to describe the operational phases in the folding process in accordance with the instant invention, presuming that the linen is to be double-folded and has already been placed on the conveyor (N1).

The main motor drives the pulley (P4) and through the belts (T1) and (T2) respectively sets in motion the roller (1) and the rollers (2), (3) and (6) all at the same time; the convevor (N2) is, however, driven by its own motor (M2).

Along the convevor (N1) is provided a photoelectric cell (E) the signals from which activate an electronic memory which controls each operational phase according to a preset programme for each article of linen as a manual push-button selector has been provided for each article to be folded.

Therefore, at preset intervals, depending on the type of linen preselected, the following operational phases occur (presuming that a double fold is required):

a) the article of linen moves along the conveyor (N1) towards the rollers (6) and (1) which grip and push it over a flat-toothed rake (R2) which supports it, making a retractabele bridge between the beginning of the convevor (N2) and the point of exit from the aforesaid pair of rollers;

b) the article of linen moves upwards along convevor (N2);

after a preset interval from the moment when the photoelectric cell (E) intercepts, the motor (M2) of the convevor (N2) is stopped and simultaneouslv the rake (R2) is moved backwards bv means of the hvdraulic ram (G) and compressed air is released from the duct (C1) into the area between rollers (1) and (2);

d) a first fold is made in the article of linen; this fold tends automatically to push itself between the rollers (1) and (2) but it is also pushed bv the jets of compressed air. Said rollers grip and pull the article of linen downwards;

e) the fold is placed onto the teeth of the rake (R1) which is in a forward position almost touching the roller (2), the article then slides down the inclined plane (S);

f) the rake (R1) after a preset time from when the photoelectric cell (E) intercepts, suddenlv moves backwards and at the same time compressed air is released from the duct (C2) into the area between rollers (2) and (3);

g) the second fold is made in the article of linen; a fold which automaticallv tends to push itself between rollers (2) and (3) but is also pushed bv the jets of compressed air. These rollers grip and pull the article of linen sidewavs depositing it onto the horizontal convevor (N3) situated upstream from the aforesaid pair of rollers.

Should the second fold not be required, the first fold on leaving the rollers (1) and (2) automaticallv passes between the rollers (2) and (3) as, in this case, the rake (R1) is set back and therefore not able to pull the article of linen down between the rollers (1) and (2).

With regard to this it should be noted that the roller (3) is laterallv offset with respect to the roller (2) found above it, preciselv to allow said roller (3) to independentlv catch hold of the article of linen which is descending from the pair of rollers (1) and (2) whenever the rake (R1) is set back.

It should also be emphasized that the fold in the article of linen

occurs automatically as a part of the linen is on a fixed table whilst the other part continues to be moved forward.

The presence and the action of the jets of compressed air, therefore, are not really necessary but they are simply extras to ensure a more reliable performance.

Still referring to figure (2), it should be noted that pulleys (P2) and (P6) are beld respectively on the ends of two support arms (9) which are both binged to plate (7). Two threaded support rods (8a) and (9a), which are cushioned, are provided in order to be able to regulate the distance between the centres of rollers (1) and (6) on the one side, and the pair of rollers (2) and (3), on the other side, depending on the thickness of the article to be folded.

Letter (G) indicates the jockey pulley supported by a ball-crank lever (10) which is hinged to the plate (7) and supported by a threaded rod (11) bearing a shock-absorber spring (12).

With reference to figures 3, 4, 5 and 6 the fully automatic folding machine, in accordance with the herein described invention, comprises two stations as will now be described.

The first one (101) is situated at the exit point of a wide conveyor (N1) which moves forward horizontally and consists of numerous parallel bands of material placed close to one another.

Immediately upstream from this station (101) a horizontal conveyor (N3) is provided onto which the folded linen is deposited from the station (101).

Under the convevor (N3) another convevor (N4) as wide as conveyor (N1) is provided. Said convevor (N4) moves at right angles to convevors (N1) and (N3) and comprises a series of straight rollers supported by a mobile frame which means that these rollers may, at the appropriate moment, move up through the gaps existing between the bands of conveyor (N3), remove the article of linen and transport it in a direction perpendicular to that of the conveyor (3).

It is not considered necessary to go into the technical and structural details of the interaction of the convevor (N3) (bands of material) and the convevor (N4) below it (rollers) since this procedure is commonly used in order to bring about 90° changes in the direction of movement.

The roller convevor (N4) deposits the article onto the conveyor consisting of material belts (N5) which, in turn, feeds a second station (102) where, obviously, the folds perpendicular to those already made, at the previous station (101), are carried out.

Upstream from the station (102) is a final convevor (N6) which moves horizontally, onto which is deposited the completely folded article of linen according to the programme set by the electronic memory belonging to the machine and preset by the user with the push-button selector for the article of linen to be folded.

The machine, therefore, according to the instant invention allows for the following combination of folds to be had:

1) a longitudinal fold and a transversal one;
2) a longitudinal fold and two transversal ones;
3) two longitudinal folds and a transversal one;
4) two longitudinal folds and two transversal ones.

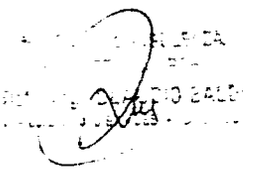
It should be noted that in the preferred embodiment of the machine according to the herein described invention, illustrated in figures 3, 4, 5 and 6, all the convevors (N1), (N2), (N3), (N4), (N5) and (N6) can have more than the two independently forward moving tracks shown in the example, which means that the number of compressed air ducts must be equal to the number of moving tracks and in the same way there must be a photoelectric cell for each track.

This means that in the case of smaller sized linen (for example, napkins or hand towels), it is possible to have several parallel folding lines, independent of one another, which gives a higher hourly rate of production.

In this case when activated a corresponding number of stop rods (two in the example, indicated respectively with numbers (103) and (104), descend onto the conveyor (N3). Said rods act both as a guide and a barrier to the linen during their transfer from convevor (N3) to conveyor (N4) and during the following phase of forward movement in the new direction.

It should be clear that this specification refers to only one preferred embodiment of the machine according to the instant invention with the omission of the structural details regarding the pneumatic system, the electric system or the electronic memory in that these are common knowledge to experts in this field.

Therefore, it is understood that the present invention is susceptible of numerous changes and modifications, above all concerning the structure, as known to a person skilled in the art and still come within the scope of the invention herein described with reference to and as indicated by the accompanving drawings.



Claims

1) Process for the automatic folding, in sequence, of napkins, towels, pillow cases, tablecloths, sheets, after they have been washed and ironed, characterized by the following operational phases:

a) the article of linen moves along a horizontal conveyor;

b) the article of linen coming off the aforesaid conveyor, passes over two rollers, on a horizontal axis and placed one above the other, which grip and push the article forwards over a flat-toothed rake which, acting as a bridge, carry it to the entry point of another conveyor with a forward-umward movement;

c) at the appropriate moment the conveyor with forward-umward movement is stopped and simultaneously the aforesaid rake moves backwards;

d) a fold is made in the article of linen, parallel to the axis of the aforesaid rollers; a fold which progressively deepens in the space left by the rake which has now moved back until it is gripped between the two adjacent horizontal rollers, slightly offset from one another, which pull and push the folded linen downwards;

e) a retractable flat-toothed rake intercepts the descending article of linen and, since said rake projects from the upper surface of an inclined plane situated under the pair of rollers indicated above, the article slides down said plane;

f) the rake indicated above, at the appropriate moment, moves back, thus a second fold in the article of linen is made level with the upper edge of the aforesaid inclined plane; this fold progressively deepens in the space left by the rake which has now moved back, until

it reaches a third roller on a horizontal axis which coordinates with one of the two adjacent rollers, see point d), in such a way that the fold is gripped by the two slightly offset rollers placed one above the other. These rollers push and place the fold sideways onto a conveyor upstream of the rollers placed one above the other, so that, should this second fold not be required, the rake indicated above which is now set back, cannot intercept and send the article of linen along the aforesaid slide, the article, in this case automatically passes between the two rollers placed one above the other.

2) Process for the automatic folding in sequence of napkins, towels, pillow cases, tablecloths and sheets after they have been washed and ironed according to the previous claim, characterized by the fact that, during the formation of the fold (phase d) and phase f)), jets of compressed air may also intervene to obtain a more reliable performance. Said jets hit the linen in a rectilinear direction parallel to the axis of the aforesaid rollers in order to facilitate and ensure the folding of the article.

3) Station for the carrying out of the folding process as claimed in the preceding claim characterized by:

a) a main group of three rollers, on a horizontal axis, equal in diameter, situated close together and in such a way that the first and second roller, in accordance with the forward movement of the article of linen, are adjacent and slightly offset with respect to a horizontal plane, in that the second roller is lower than the first; the second and third rollers, instead, are one above the other and slightly offset with respect to a vertical plane, and the third roller below the second one is laterally offset towards the first roller;

b) a fourth roller on a horizontal axis placed exactly above the aforesaid first roller;

c) a conveyor with a forward-upward movement, upstream from the first roller and immediately over the second roller;

d) a flat-toothed rake provided at the entry point to the aforesaid convevor, for temporarily holding the article of linen at the exit point of the first and fourth roller;

e) an inclined plane found under the first roller the upper edge of which is close to the top and side of the third roller; the edge of said slide is provided with a plurality of notches, regularly spaced, into which fit the flat teeth of a rake which may be pushed forward by a hydraulic ram fixed under the slide until it just touches the second roller;

f) two thin tubular ducts on a horizontal axis perforated along a generating line, and from which, at the appropriate moment, jets of compressed air are released. The first duct is placed immediately above the beginning of the aforesaid convevor, and the second duct is placed immediately above the upper edge of the aforesaid slide in front of the entry point between the second and third roller.

4) Station, as claimed in the preceding claims, characterized by the fact that the second, third and fourth roller, on the one side, and the first roller, on the other side are deiven by two independent drive belts from the same pulley, which in turn, is connected by another drive belt to the main motor. The aforesaid convevor with a forward-umward movement is provided with its own motor and the second and fourth roller with flexible bearings so that the centre distances between the pairs of rollers may be regulated according to the thickness of the article of linen to be folded.

5) Folding machine, fully automatic, which carries out the following process claimed in claims 1), and 2), characterized by:
a) a first station, as claimed in claim 3), fed by a convevor with a forward-hori-ontal movement, comprising numerous parallel bands of material placed close to one another, onto which the ironed linen is placed and conveved towards the entry point between the aforesaid first and fourth rollers;

b) a second convevor with a forward-horizontal movement as wide as the above convevor, also comprising numerous parallel bands of material, onto which the folded linen is deposited on leaving the aforesaid second and third rollers;

c) a convevor moving at right angles to the aforesaid convevors, comprising a series of metal rollers supported by a mobile frame which means that these rollers move up through the gaps existing between the bands of the aforesaid second convevor, remove the article of linen and transport it in a direction perpendicular to that of the second convevor;

d) a third convevor with a forward-horizontal movement, the same as the aforesaid first convevor, fed by the roller convevor claimed above;

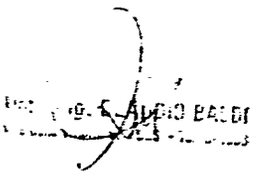
e) a second station, as claimed in claim 3), fed by the third conveyor, where folds perpendicular to those already made at the first station are carried out on the article of linen:

f) a fourth convevor with a forward-horizontal movement, as wide as the third convevor, which receives the linen leaving the second station;

g) an electronic panel where the folding procedures and times are programmed for each article of linen, as each of the feed belts of the stations is provided with a photoelectric cell, the signals of which activate the electronic panel which sets in motion each of the operational phases according to a preset and memorized programme for each article of linen, there also being a push-button selector for each article to be folded.

6) Folding machine, fully automatic, as claimed in the preceding claims, characterized by a second preferred embodiment wherein all the aforesaid convevors may have several independently forward moving tracks, also means that the compressed air ducts, the roller convevors and the photoelectric cells must be equal to the number of moving tracks. In this case, when activated a corresponding number of stop rods descend onto the second convevor in order to act both as a barrier and a guide to the linen during their transfer from the second convevor

the roller conveyor during the following phase of forward movement in the new direction.



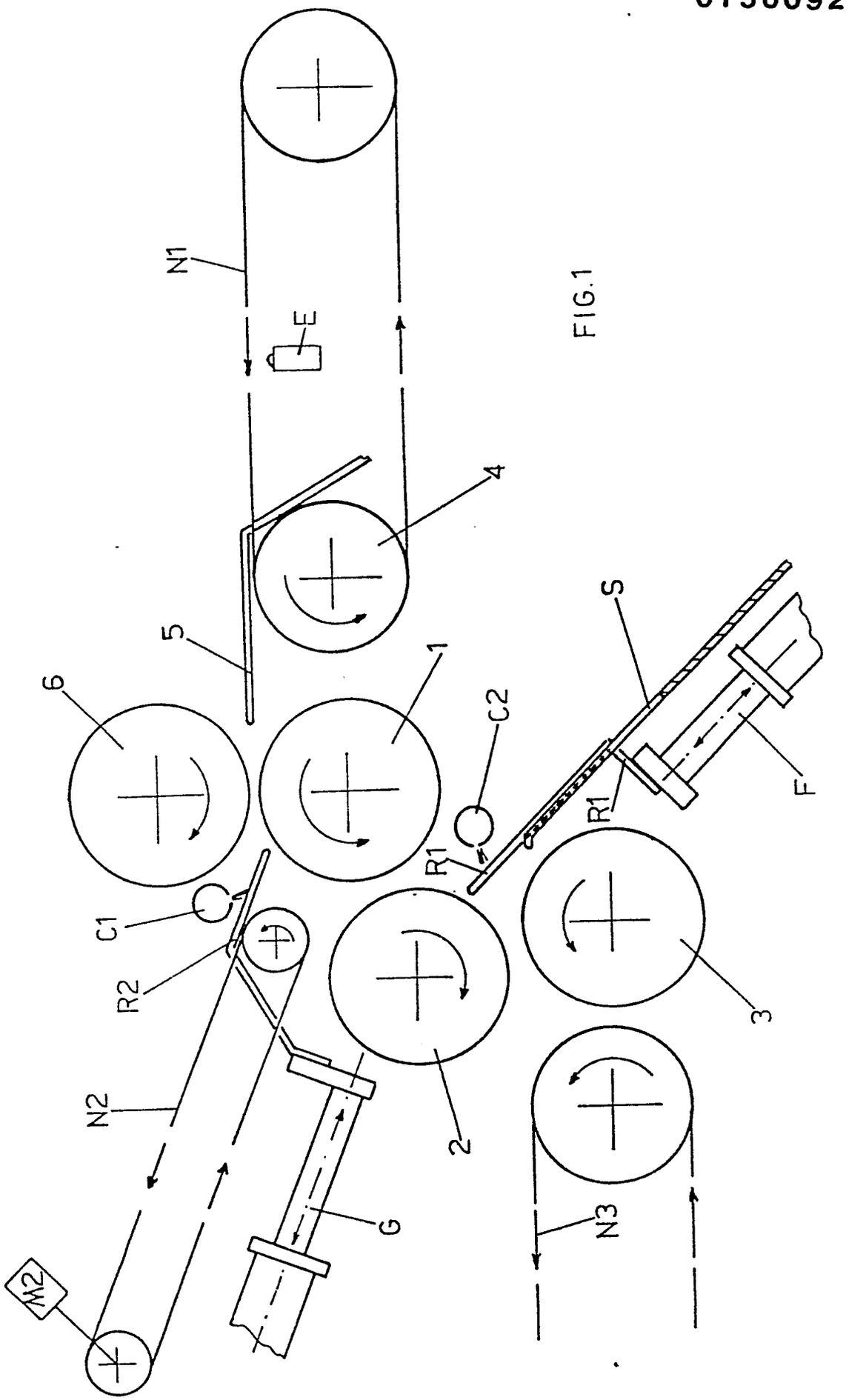


FIG.1

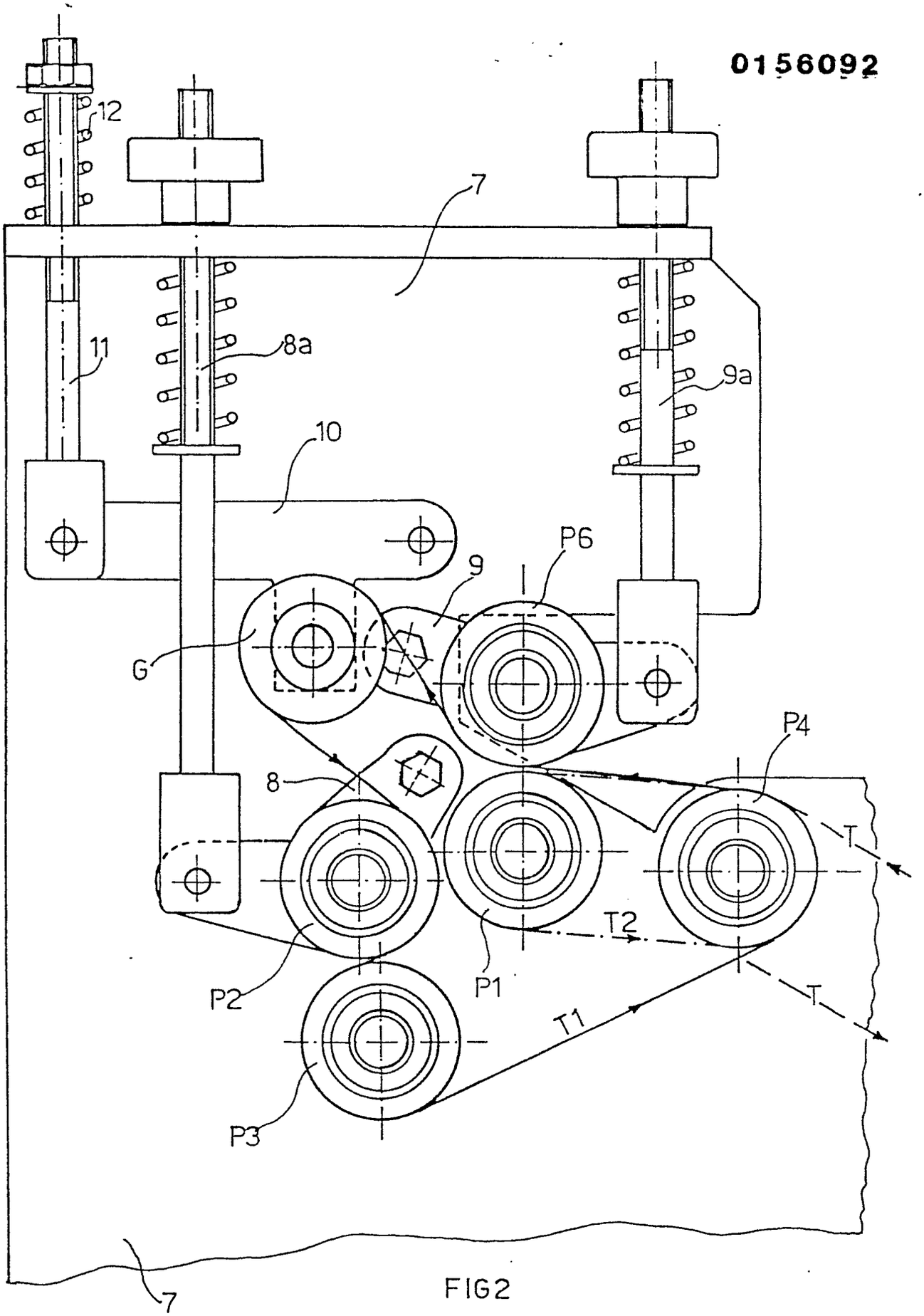


FIG2

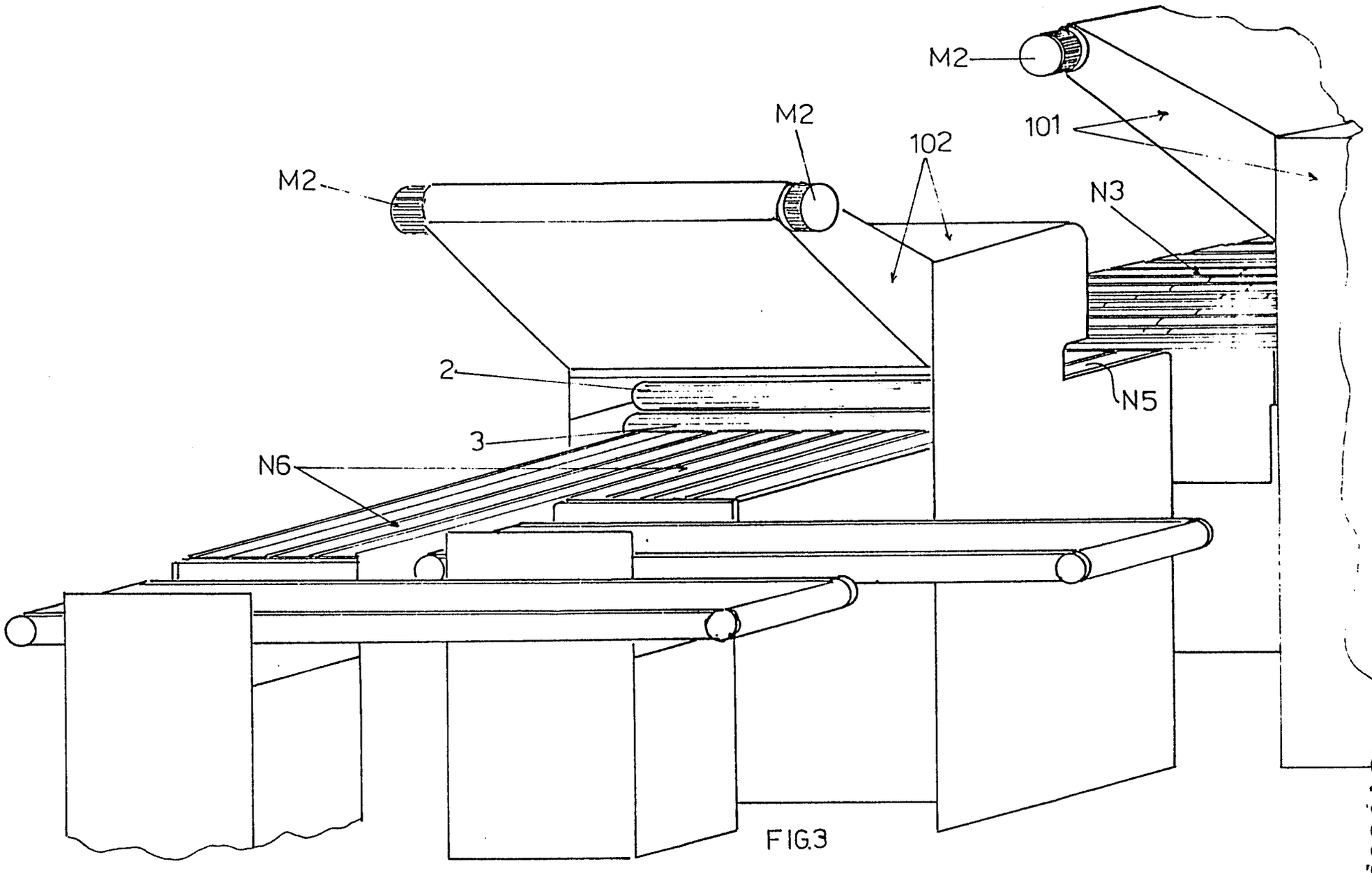


FIG.3

TAV. III-6

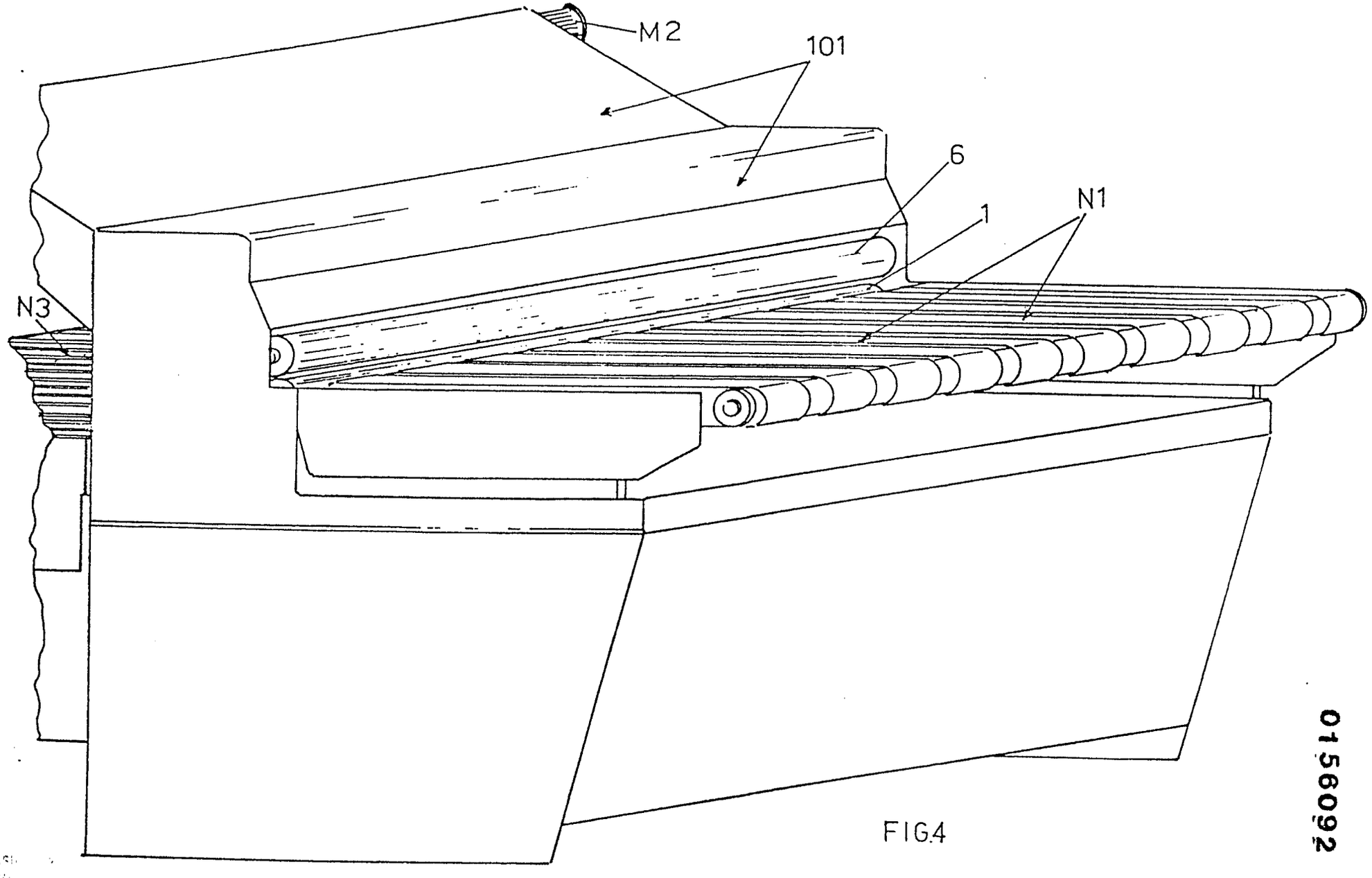


FIG.4

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TAV. IV-6

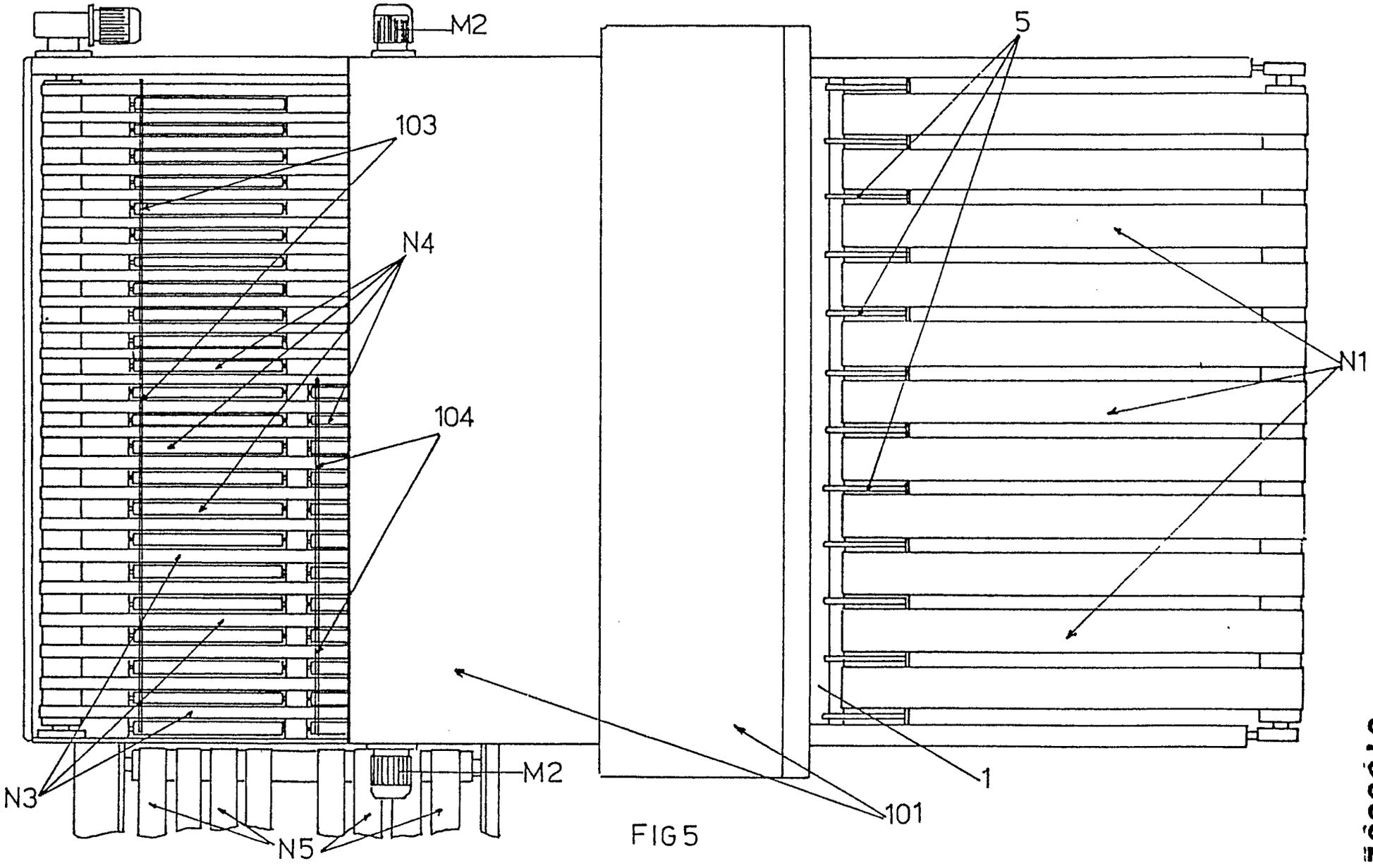

FIG 5

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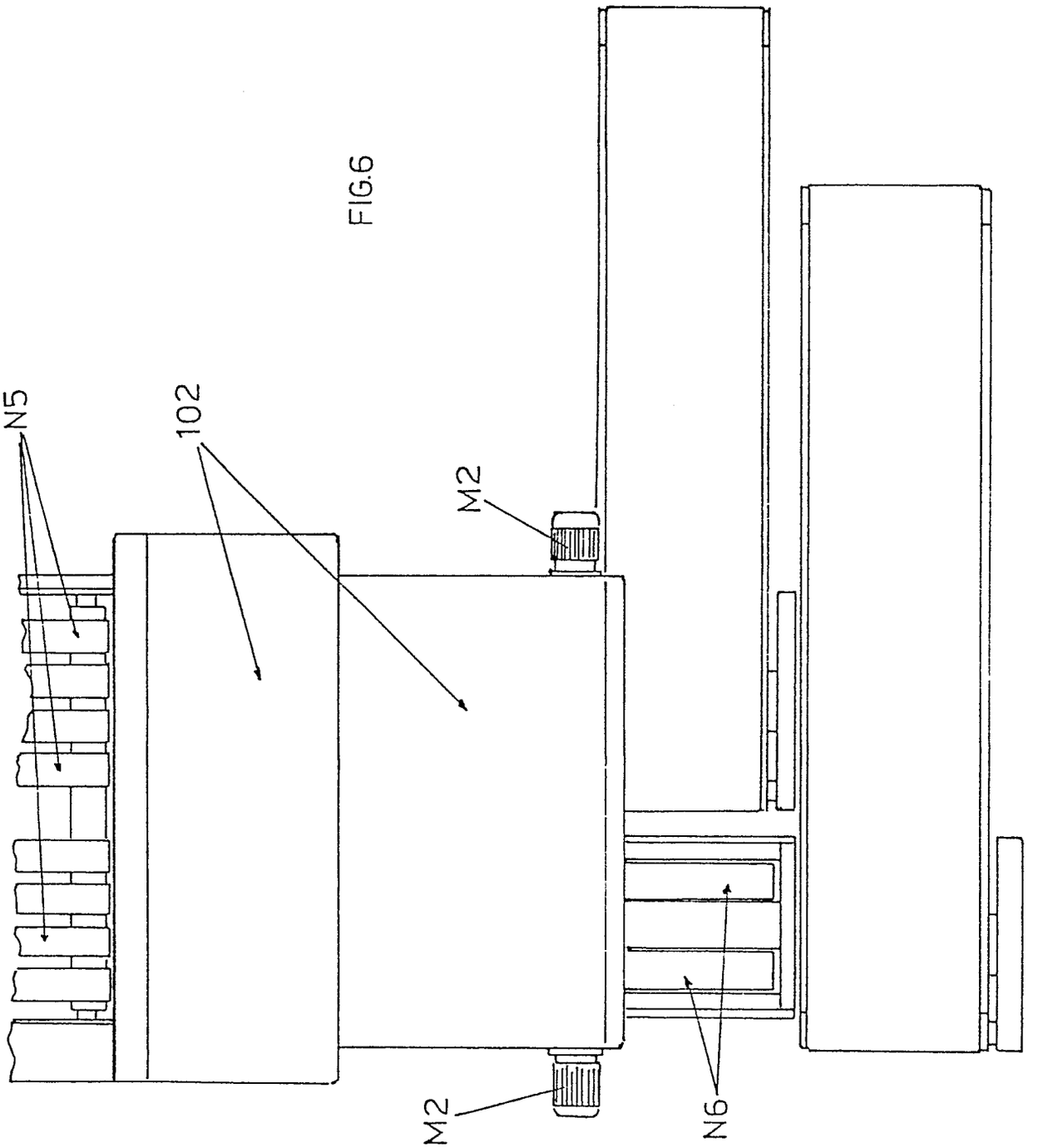
TAV. V-6

TAV. VI-6

FIG.6



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EUROPEAN SEARCH REPORT

0156092
Application number

EP 84 83 0088

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	US-A-4 234 179 (WEIR) * whole document *	1-3,5,6	B 65 H 45/04
A	GB-A-2 120 295 (THOMAS BROADBENT & SONS LTD.) * whole document *	1-3,5,6	
A	DE-A-3 103 468 (WILH. CORDES GmbH & CO.) * whole document *	1-3,5,6	
A	US-A-2 804 298 (BUSS)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			B 65 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-10-1984	RECHLER W.

CATEGORY OF CITED DOCUMENTS

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