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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Folding machine for folding sheet material in a concertina fashion.**

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Courier Press, Leamington Spa, England.

Description

This invention relates to a folding machine for folding sheet material in concertina fashion according to the first portion of claim 1.

Italian Patent specification No. 906.210 and 911.967 discloses such folding machines.

The Italian Patent No. 906.210 (=GB—A—1349 558) relates to a folding machine comprising three contiguous rollers, the central lower roller being simultaneously in constant contact with both the two lateral upper rollers. All the rollers rotate in both the directions, alternatively, in order to produce zig-zag or concertina-like folds in a paper material; the central roller cooperates alternatively with one of the two lateral rollers, acting as a folding roller.

The Italian Patent No. 911.967 relates to a folding machine which comprises, as the above mentioned machine, three rollers.

The central lower roller is on contact, alternatively, with only one of the two upper rollers in turn and for this reason the lower roller is moved towards the right and towards the left, alternately.

It is also known from the specification DE—A—2227582 Meteor a zig-zag paper folder in which the folding elements are constituted by two pairs of rollers 4—6 and 3—5; the rollers 5 and 6 must be able to be moved away from the rollers 3 and 4 in order to receive between each pair a plurality of layers of folded sheets. Two sets of belts, interposed to each other, are mounted on said rollers to retain the paper; they have a rectilinear speed equal to the peripheral speed of the folding rollers which support them.

EP—A—0037650 HARPER provides two pairs of folding rolls 5—7 and 4—6. The incoming papers, which rests on a stationary plate 14, is addressed, by a swinging or rotating deflecting element 16 or 13, towards the right or towards the left. The present machine is intended to enable sheet material such as paper to be folded in concertina fashion whilst being responsive to different kinds and thickness of paper sheets by utilizing the capabilities of electronic microprocessors.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figures 1, 2 and 3 are schematic vertical elevational views respectively showing three different operative positions of a folding machine, viz. at an initial stage of an operating cycle, after a first reversal condition and after a second reversal condition to produce sheet material which has been folded in concertina fashion.

Figure 4 shows different folding stages of a sheet to provide complete concertina folding of the sheet, and

Figure 5 is a diagrammatic perspective view of part of the folding machine, this Figure showing feeding rollers and feed path in phantom.

The general construction of the machine will first be described.

A horizontal table TA is provided for feeding longitudinal sheets FO (Figure 4) of material such as paper to be concertina folded to an inlet location and a feed means is provided in the form of a unidirectionally driving inlet roller RM^1 cooperating with associated idler rollers (or balls) RF^1 and RF^2, these rollers serving to feed the sheets to an entry path or track CE.

NA^1 and NA^2 are sets of strongly tensioned endless bands extending around driving rollers RM^2 and RM^3 and around idler rollers RF^2 and RF^3 respectively, these bands being arranged at the folding station according to a specular symmetry about the plane of the intended direction of feed of the sheet material along the inlet path CE. Respective working runs of the bands NA^1 and NA^2 are arranged tangentially with respect to idler rollers RF^4 and RF^5, these rollers RF^4 and RF^5 having respective tapered portions PE^1 and PE^2 and toroidal guide grooves SC^1 and SC^2 to accommodate endless belts CN wound around a pair of lower rollers RM^4 and RF^6. The roller RM^4 is driven and its direction of rotation can be reversed and the roller RF^6 is an idler roller. Accordingly, the rollers RM^2 and RM^3 drive respectively the rollers RF^4 and RF^5 via the bands NA^1 and NA^2.

Another roller RO is arranged to be driven in a direction which depends on the direction of rotation of the driving rollers RM^2, RM^3 and RM^4 and is shiftable in said plane from an upper position (Figure 1) at the beginning of the operating cycle in order to direct the sheet material towards the band NA^2 and a lower position, which is achieved after the beginning of the cycle, whilst continuing to rotate in the same direction as the roller RM^4, in order not to hinder the formation of folds in the sheet material (Figures 2 and 3).

Detecting means in the form of photoelectric cells CF^1 and CF^2 control the directions of rotation of the driving rollers RM^2, RM^3 and RM^4. In addition, a photoelectric cell CF^3 is located adjacent to the entry path CE.

In operation, starting from the Figure 1 position, the driving roller RM^1 feeds the sheet FO towards the entry path CE until the sheet drops to the folding station to meet the rotating roller RO (which is in its upper position) so that the sheet is directed between the lower, working run of the band NA^2 and the roller RF^5 and consequently the sheet is positively carried towards the photoelectric cell CF^1. As soon as the leading edge of the sheet breaks the light beam directed towards the photoelectric cell, a servocontrol causes the direction of rotation of the driving rollers RM^3 and RM^4 to be reversed, whilst the driving roller RM^1 continues to rotate always in the same initial direction. As can be seen from Figure 2, this has the effect of drawing the sheet material such as paper to form a loop to provide a first fold therein. The photoelectric cell CF^3 mounted in the entry path CE is instrumental in initiating the rotation of the rollers RM^2, RM^3, RM^4 and RO.

The same cycle is then repeated but in the opposite direction as soon as the next leading (folded) edge of the sheet reaches the photoelec-

tric cell CF^2. The folding cycles are repeated till the exhaustion of the length of sheet matrerial being fed in, so that it becomes folded in concertina fashion (Figure 4). Provision may be made for microprocessors co-operating with the photoelectric cells CF^1, CF^2 in order to survey and regulate the folding of the sheets. Comparing Figures 1 and 2, after the first fold has been made, the roller RO is shifted into its lower position and remains in that position as a result of a control impulse given by the photoelectric cell F^4. The roller RO is driven in synchronism with the roller RM^4 and this achieves a rolling support for the sheet to be folded.

It will be appreciated that the present folding machine does not have stationary channels between which the pack of folded sheet material can slide during the folding operation as with a known machine; on the contrary, the "channels" are movable and consist of the belts CN and bands NA^1, NA^2 which accompany the material during the reciprocating movement whereby movement of the material is not hindered thereby inhibiting consequent jamming of the machine.

Furthermore, the utilisation of one or more bands NA^1, NA^2 in lieu of a rigid roller in order to carry out the deflection of the fold against the rollers RF^4, RF^5 permits a better performance to be obtained than that obtained with known folding machines, since the surfaces of the bands between the rollers can yield and permit the passage of folded paper packets presenting a significant thickness. The choice of a second folding roller as provided in known folding machines for small sheets would force the second roller to lose its initial parallelism if a sheet is folded which presents a width less than that of the second roller. Consequently the pressure upon the paper would not be uniform and the operation would not be correct. In a preferred embodiment of the present machine, it is possible to fold sheets having a number of different lengths and widths up to 10 meters.

It will be further appreciated that the provision of the roller RO performs the important job of orientating correctly the leading border of the paper, so as to orientate the latter according to the required inlet or feed direction, without sensing the initial pre-bending that the paper may present in the opposite direction.

The arrangement of two folding sets as shown in Figure 1 permits a pyramid effect to be eliminated, this effect being present in the known roller type folding machine. This effect is usually present when relatively long sheets have to be folded since, if the number of folded portions is increased, the latter results always in that each succeeding sheet folded is a little shorter than the preceding folded layers, so that the paper concertina folded packet so produced will present a pyramid shape.

Claims

1. A folding machine for folding sheet material in concertina fashion, the machine comprising: means to feed the material along a path (CE) towards a folding station; directing means to address initially the sheet forward end to the right or left hand; two folding means moving alternatively towards the right or left direction; means to support the folded paper; and means to detect the forward edges of the sheet material as it proceeds forwards, to cause the inversion of the command of the roller and band system, to produce the folds, characterized in that each one of said two folding means consists of an endless annular band (NA^1; NA^2) supported by a first and a second roller couple (RF^2—RM^2, FM^3—RF^3), and of a third roller (RF^4, RF^5) in contact with said endless band (NA^1, NA^2) at a position between the respective rollers; the directory means consists of a roller (RO) which is vertically shiftable from a first upper active position to a second non-active lower position after the paper forward end has been addressed either to the right or to the left hand and that said means of support of the folded sheet consists of a single belt ensemble (CN) carried by a roller couple (RF^6, RM^4) the translation speed of which being preferably slightly higher than that of said bands (NA^1—NA^2).

2. Folding machine according to claim 1, wherein the rectilinear movement of the lower portions of said two folding bands (NA^1 and NA^2) and the movement of the upper portion of said belt ensemble (CN) supporting the sheet material is alternative and concordant.

3. Folding machine according to claims 1 and 2, wherein the rotation movement of the directional means (RO) is concordant with the rectilinear movement of the lower portions of the two folding bands (NA^1, NA^2), i.e. the rotation of the directional roller (RO) takes place in the same direction of the rotation of the folding rollers (RF^4, RF^5).

4. Folding machine according to from 1 to 3, wherein the rotation of directional roller (RO) in one or in the other rotation direction takes place in the first position or upper position of said roller (RO) in order to favour in the initial phase the addressing of the leading edge of the sheet to be folded towards the right or left hand, and thereafter same roller (RO) is lowered, with or without any rotation in neither direction, to a second lower position of disengagement from the paper sheet, said sheet being supported by said series of small belts (CN) which accompany the paper with alternative movement in the two opposite directions, alternatively firstly in one direction and then in the other direction.

5. A folding machine as claimed in claim 1 wherein said feed means comprises a feed roller (RM^1) which cooperates with idler means (RF^1, RF^2).

6. A folding machine as claimed in claim 5, wherein said idler means comprises idler rollers or balls.

7. A folding machine as claimed in any one of the preceding claims, wherein said third pair of rollers are idler rollers and one of each of said first and second pairs of rollers are drive rollers.

8. A folding machine as claimed in claim 7 and

further comprising a fourth pair of rollers (RM^4, RF^6), one of which is a driven roller around which rollers endless belts (CN) extend to assist in conveying the sheet material being fed from said path to the respective endless bands as folding proceeds, said endless belts also extending around grooves in said third pair of rollers so as to prevent any misleading of the sheet to be folded.

9. Folding machine according to claims 1 to 8, wherein said sheet detecting means, in the form of photoelectric cells, are arranged in a position adjacent to each working portion of said endless bands.

10. A folding machine as claimed in claim 9, wherein said photoelectric cells are coupled with microprocessors controlling actuation of the machine and further comprising means (CF^3) in said feed path to detect the arrival of sheet material to initiate an operating cycle.

Patentansprüche

1. Faltmaschine zum Falten blattartigen Materials zu einer Concertina-Faltung umfassend Einrichtungen zum Zuführen des Materials längs eines Weges (CE) auf eine Faltstation zu; Führungseinrichtungen, um zunächst das vordere Blattende nach links oder rechts zu dirigieren; zwei Falteinrichtungen, welche sich alternativ nach links oder rechts bewegen; Aufnahme-Einrichtungen für das gefaltete Papier; Einrichtungen zur Erfassung der Vorderkanten des blattförmigen Materials bei der Vorwärtsbewegung zur Umkehrung der Steuerung des Rollen- und Bandsystems zur Herstellung der Faltungen, dadurch gekennzeichnet, daß jede der beiden Falteinrichtungen aus einem endlosen ringförmigen Band (NA^1; NA^2) besteht, welches durch ein erstes und zweites Rollenpaar getragen wird (RF^2—RM^2, FM^3—RF^3) und dritte Rollen (RF^4, RF^5), welche zwischen den jeweiligen Rollen in Kontakt mit dem endlosen Band (NA^1, Na^2) stehen; Führungseinrichtungen bestehend aus einer Rolle (RO), welche vertikal von einer ersten oberen, aktiven Position zu einer zweiten unteren, nicht aktiven Position verschiebbar ist, nachdem das Vorderende des Papiers entweder nach links oder nach rechts geleitet wurde, wobei die Aufnahme-Einrichtungen für die gefalteten Blätter aus einer einzigen Riemenanordnung (CN) bestehen, welche durch ein Rollenpaar (RF^6, RM^4) getragen wird, dessen Translationsgeschwindigkeit vorzugsweise leicht höher ist als diejenige der Bänder (NA^1—NA^2).

2. Faltmaschine nach Anspruch 1, dadurch gekennzeichnet, daß die geradlinige Bewegung der unteren Abschnitte der beiden Faltbänder (NA^1 und NA^2) und die Bewegung des oberen Teils der Reimenanordnung (CN), welche das blattförmige Material trägt, abwechselnd und koordiniert erfolgt.

3. Faltmaschine nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Drehbewegung der Führungseinrichtungen (RO) koordiniert mit der Linearbewegung der unteren Abschnitte der beiden Faltbänder (NA^1, NA^2) verläuft, d.h. die Drehbewegung der Führungsrollen (RO) erfolgt in der gleichen Richtung wie die Drehung der Faltrollen (RF^4, RF_2).

4. Faltmaschine nach den Ansprüchen 1 bis 3, dadurch gekennzeichnet, daß die Drehung der Führungsrollen (RO) in die eine oder andere Drehrichtung in der ersten oder oberen Position der Rollen (RO) stattfindet, um in der Anfangsphase die Führung der Vorderkante der zu faltenden Blätter nach links oder rechts zu unterstützen, wobei danach dieselbe Rolle (RO) abgesenkt wird, wobei keine oder eine Rotation in irgendeine Richtung stattfindet, in eine zweite untere Position außer Eingriff mit den Blättern, wobei die Blätter durch die Reihe von kleinen Riemen (CN) getragen wird, welche das Papier unter abwechselnder Bewegung in die beiden entgegengesetzten Richtungen begleiten, abwechselnd erst in eine Richtung und dann in die andere Richtung.

5. Faltmaschine nach Anspruch 1, dadurch gekennzeichnet, daß die Zuführeinrichtungen eine Zuführrolle (RM^1) umfassen, welche mit Leerlaufeinrichtungen (RF^1, RF^2) zusammenwirken.

6. Faltmaschine nach Anspruch 5, dadurch gekennzeichnet, daß die Leerlaufeinrichtungen eine Schleppwalze oder Schlepprollen umfaßt.

7. Faltmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das dritte Rollenpaar Schlepprollen sind und eines der ersten und zweiten Rollenpaare Treibrollen sind.

8. Faltmaschine nach Anspruch 7, gekennzeichnet durch ein viertes Rollenpaar (RM^4, RF^6), wovon eine eine Treibrolle ist, wobei sich um diese Rollen endlose Gurte (CN) erstrecken, um bei dem Transport des blattförmigen Materials mitzuwirken, welches von dem ersten Transportweg zu den jeweiligen endlosen Bändern mit fortschreitender Faltung geführt wird, wobei die endlosen Gurte sich auch um Nuten in dem dritten Rollenpaar erstrecken, so daß eine Fehlleitung des zu faltenden Blattes vermieden wird.

9. Faltmaschine nach Anspruch 1 bis 8, dadurch gekennzeichnet, daß die Blatt-Erfassungseinrichtungen in Form fotoelektrischer Zellen im Bereich jeder Arbeitsposition der endlosen Bänder angeordnet sind.

10. Faltmaschine nach Anspruch 9, dadurch gekennzeichnet, daß die fotoelektrischen Zellen mit Mikroprozessoren verbunden sind, welche den Bewegungsablauf der Maschine steuern, wobei Einrichtungen (CF^3) im Zuführweg angeordnet sind, um das Ankommen des Blattmaterials zu erfassen und einen Betriebszyklus in Gang zu setzen.

Revendications

1. Plieuse pour plier en accordéon un matériau en feuille, la plieuse comprenant: des moyens pour amener le matériau le long d'un chemin (CE)

aboutissant à un poste de pliage; un moyen directionnel pour diriger au départ l'extrémité avant de la feuille vers la droite ou vers la gauche; deux moyens de pliage mobiles alternativement vers la droite ou vers la gauche; un moyen pour supporter le papier plie'; et des moyens pour détecter les bords avant du matériau en feuille lorsqu'il progresse, afin de provoquer l'inversion de la commande d'un ensemble de rouleaux et bandes, pour produire les plis, caractérisée en ce que chacun des deux susdits moyens de pliage consiste en une bande annulaire sans fin (NA^1; NA^2) portée par une première et une deuxième paires de rouleaux (RF^2—RM^2, RM^3—RF^3), et en une troisième paire de rouleaux (RF^4, RF^5) en contact avec ladite bande sans fin (NA^1, NA^2) en un emplacement situé entre les rouleaux correspondants; le moyen directionnel consiste en un rouleau (RO) qui est déplaçable verticalement depuis une première position, supérieure et active, jusqu'à une deuxième position, inférieure et non active, atteinte après que l'extrémité avant du papier a été dirigée ou vers la droite, ou vers la gauche, et en ce que ledit moyen de support de la feuille pliée consiste en un seul ensemble de courroies (CN), porté par une paire de rouleaux (RF^6, RM^4), dont la vitesse de translation est de préférence légèrement plus élevée que celle desdites bandes (NA^1—NA^2).

2. Plieuse selon la revendication 1, dans laquelle le mouvement rectiligne des parties inférieures des deux susdites bandes de pliage (NA^1 et NA^2) et le mouvement de la partie supérieure dudit ensemble de courroies (CN) supportant le matériau en feuille sont alternatifs et concomitants.

3. Plieuse selon les revendications 1 et 2, dans laquelle le mouvement de rotation du moyen directionnel (RO) est en concordance avec le mouvement rectiligne des parties inférieures des deux bandes de pliage (NA^1, NA^2), c'est-à-dire que la rotation du rouleau directionnel (RO) s'effectue dans le même sens que la rotation des rouleaux de pliage (RF^4, RF^5).

4. Plieuse selon les revendications 1 à 3, dans laquelle la rotation du rouleau directionnel (RO), dans l'un ou l'autre sens de rotation, s'effectue lorsque ledit rouleau (RO) se trouve dans la première position ou position supérieure, afin de favoriser lors de la phase initiale le guidage du bord menant de la feuille à plier vers la droite ou vers la gauche, et ensuite ce rouleau (RO) est abaissé, avec ou sans rotation dans l'un ou l'autre sens, à une deuxième position, inférieure, pour laquelle il perd le contact de la feuille de papier, ladite feuille étant supportée par ladite série de petites courroies (CN) qui accompagnent le papier par un mouvement alternatif dans les deux sens opposés, d'abord dans un sens et ensuite dans l'autre sens, alternativement.

5. Plieuse selon la revendication 1, dans laquelle ledit moyen d'alimentation comporte un rouleau d'alimentation (RM^1) qui coopère avec des moyens fous (RF^1, RF^2).

6. Plieuse selon la revendication 5, dans laquelle les moyens fous comportent des rouleaux ou billes fous.

7. Plieuse selon l'une quelconque des revendications précédentes, dans laquelle ladite troisième paire de rouleaux est constituée de rouleaux fous et l'une desdites première et deuxième paires de rouleaux sont des rouleaux d'entraînement.

8. Plieuse selon la revendication 7, comprenant en outre une quatrième paire de rouleaux (RM^4, RF^6), dont l'un est un rouleau entraîné et autour desquels passent des courroies sans fin (CN) destinées à aider au transport du matériau en feuille qui est amené depuis ledit passage jusqu'aux bandes sans fin respectives lorsque le pliage se déroule, lesdites courroies sans fin passant également dans des gorges de ladite troisième paire de rouleaux afin d'empêcher toute erreur de guidage de la feuille à plier.

9. Plieuse selon les revendications 1 à 8, dans laquelle lesdits moyens de détection des feuilles, sous la forme de cellules photo-électriques, sont placés au voisinage de chaque partie active desdites bandes sans fin.

10. Plieuse selon la revendication 9, dans laquelle lesdites cellules photo-électriques sont couplées à des microprocesseurs commandant la mise en action de la plieuse et qui comporte en outre un moyen (CF^3), placé dans ledit passage d'alimentation, qui détecte l'arrivée de matériau en feuille afin de déclencher un cycle de fonctionnement.

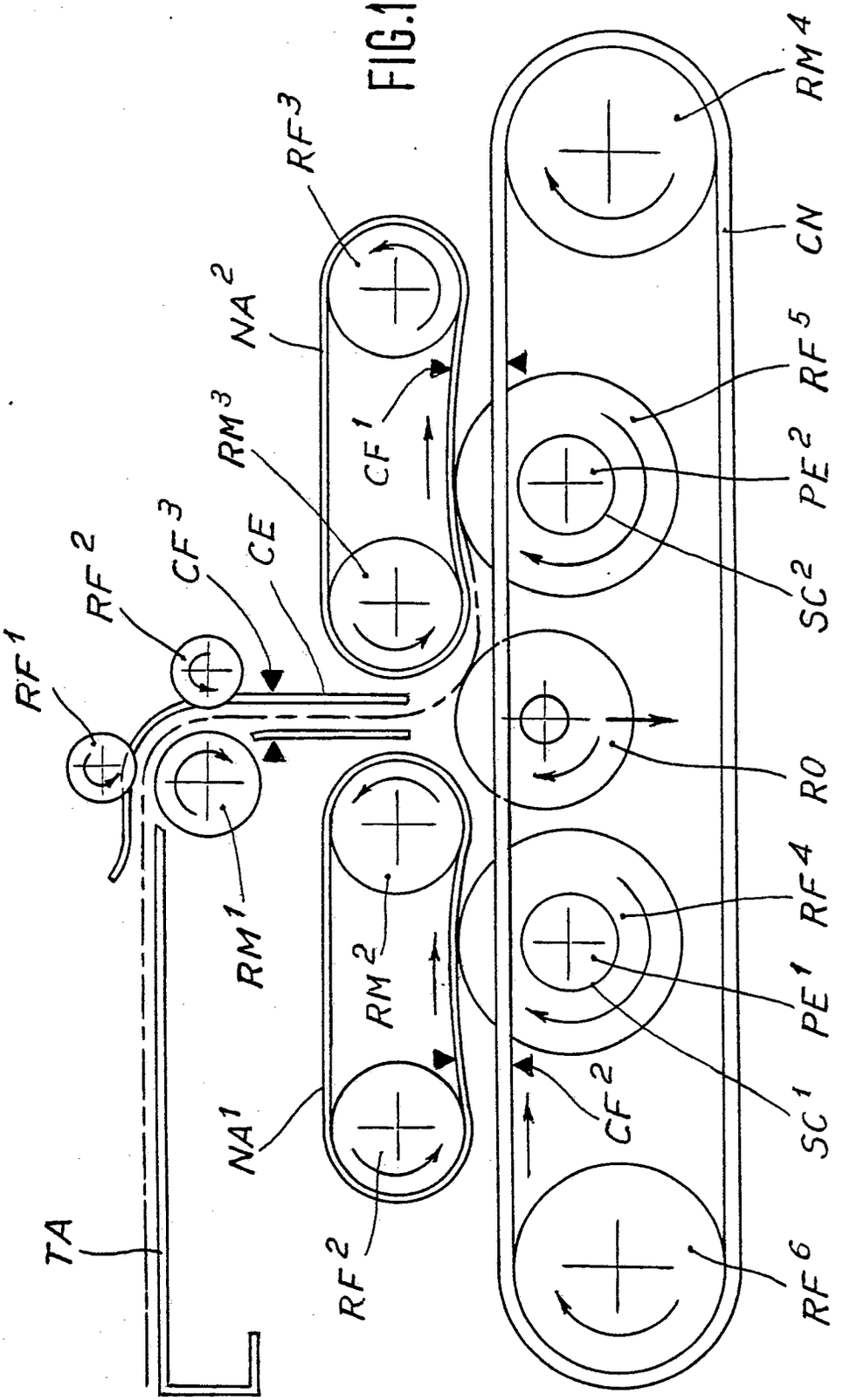

RF 1
RF 2
CF 3
CE
RF 3
NA 2
RM 3
CF 1
RM 4
CN
RF 5
PE 2
SC 2
RO
RM 1
RM 2
NA 1
CF 2
PE 1
RF 4
SC 1
TA
RF 2
RF 6

FIG.1

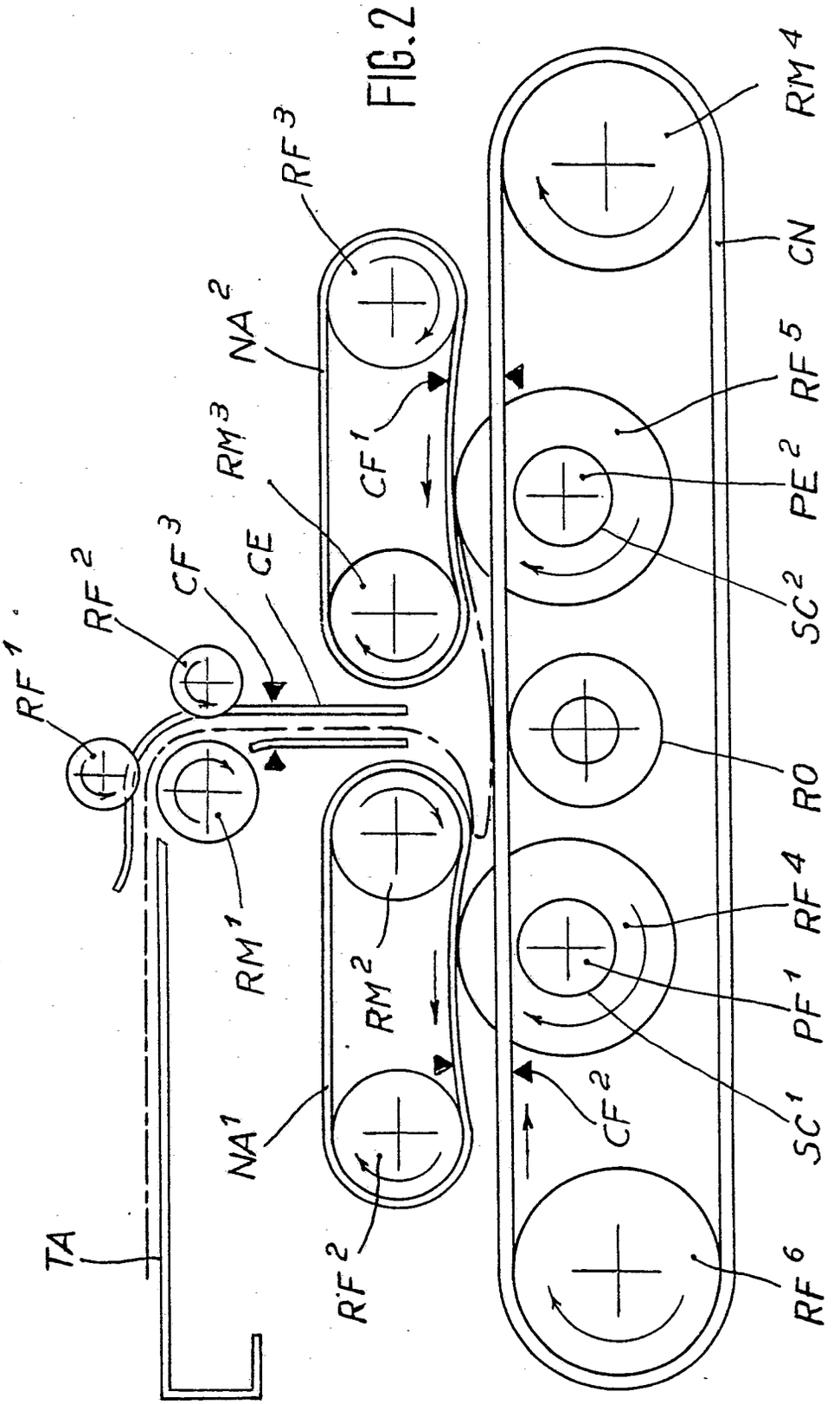

RF 1
RF 2
CF 3
CE
RM 3
NA 2
RF 3
CF 1
RM 4
CN
RF 5
PE 2
SC 2
RO
RM 1
RM 2
NA 1
RF 4
PF 1
SC 1
CF 2
TA
RF 2
RF 6

FIG.2

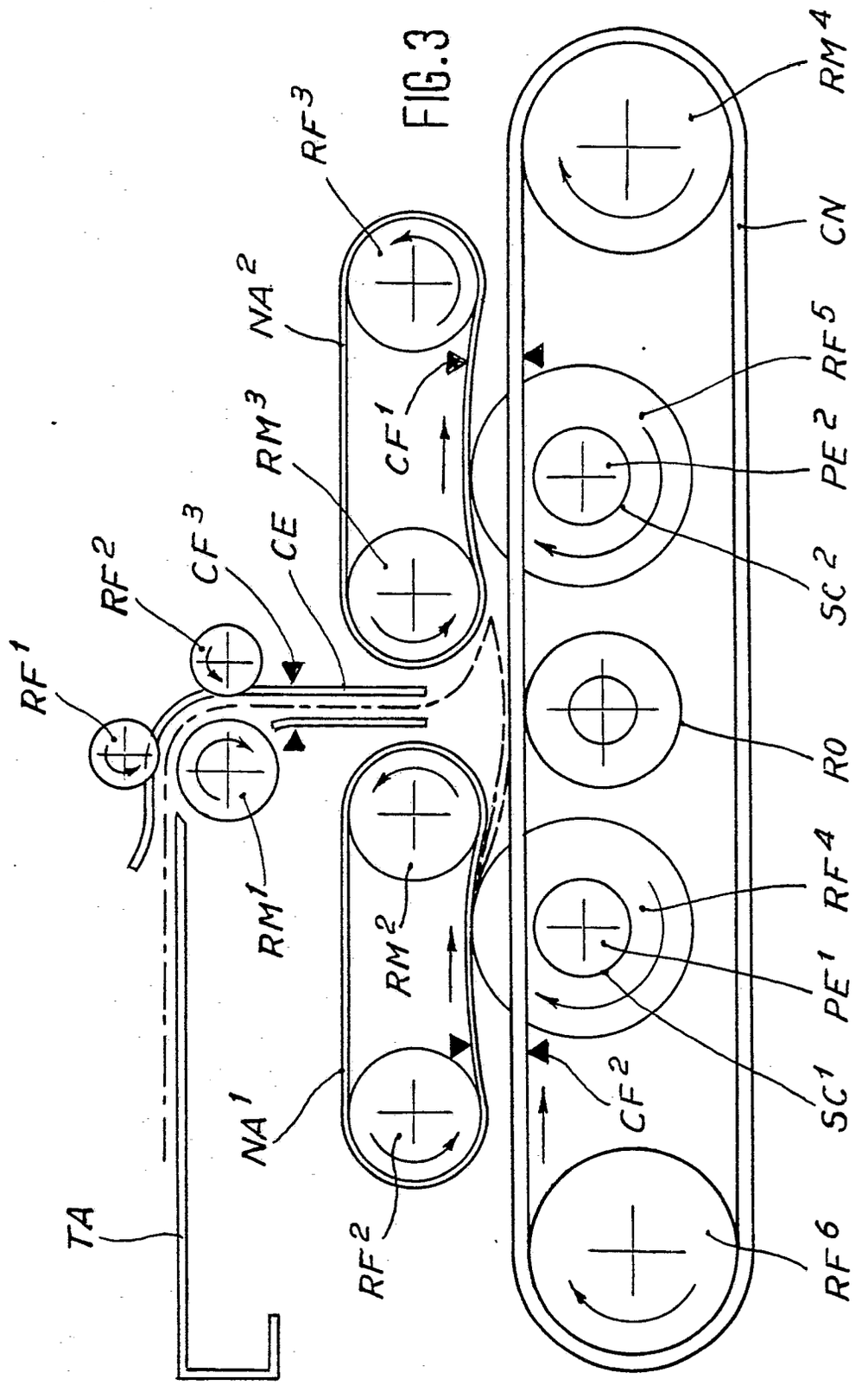

RF 1
RF 2
CF 3
CE
RM 3
NA 2
RF 3
CF 1
RM 4
CN
RF 5
PE 2
SC 2
RO
RM 1
RM 2
NA 1
CF 2
PE 1
RF 4
SC 1
TA
RF 2
RF 6

FIG.3

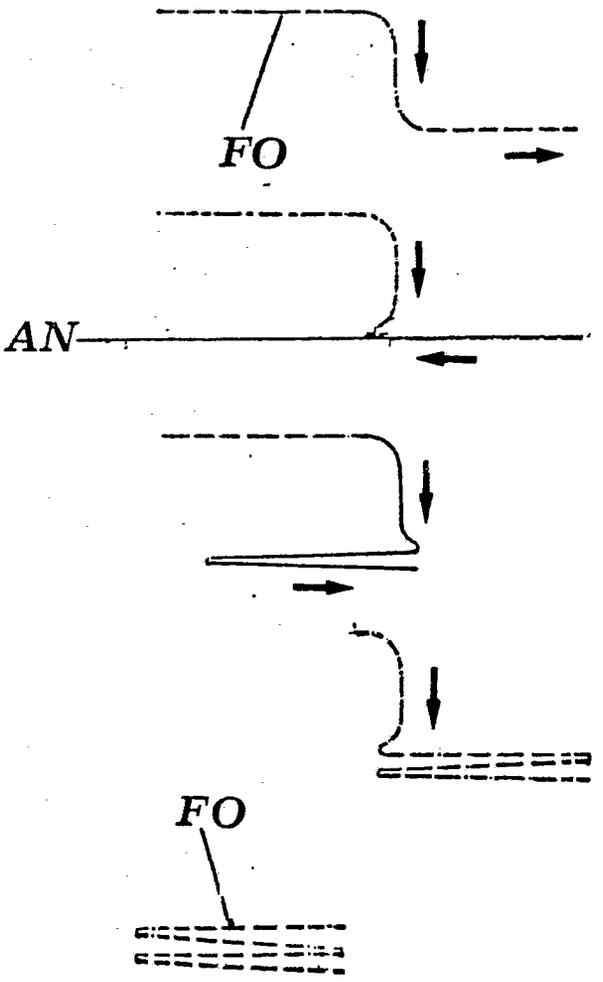


FIG.4

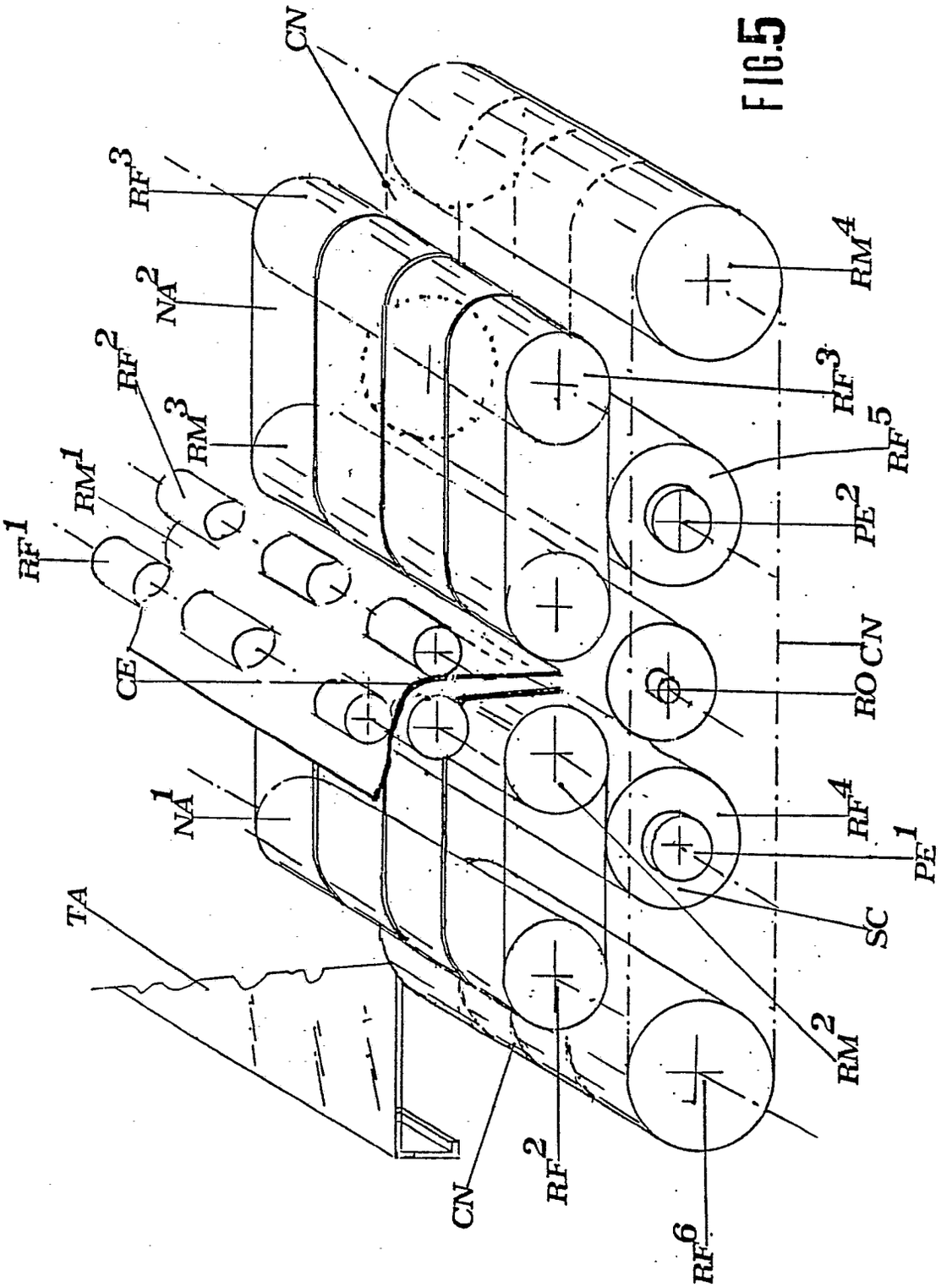

CN
RF3
NA2
RF2
RM3
RM1
RF1
CE
NA1
TA
CN
RF2
RF6
RM2
SC
PE1
RF4
RO CN
PE2
RF5
RF3
RM4

FIG.5