United States Patent

Kraft et al.

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[45] **Feb. 15, 1972**

[54] DEVICE FOR SURFACE TREATMENT OF MATERIAL

[72] Inventors: **Rupert Kraft**, Perlstrable 8; **Johannes Zimmer**, Ebenlholerstrabe 133, both of 9020 Klagenfurt, Austria

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[21] Appl. No.: **786,137**

[30] **Foreign Application Priority Data**

Dec. 29, 1967 Austria ..... A 11817/67

[52] **U.S. Cl.** **100/160**, 100/161, 100/176

[51] **Int. Cl.** **B30b 3/02**

[58] **Field of Search** ..... 100/155, 160, 169–171, 100/176; 18/2 C; 226/152; 162/358–360

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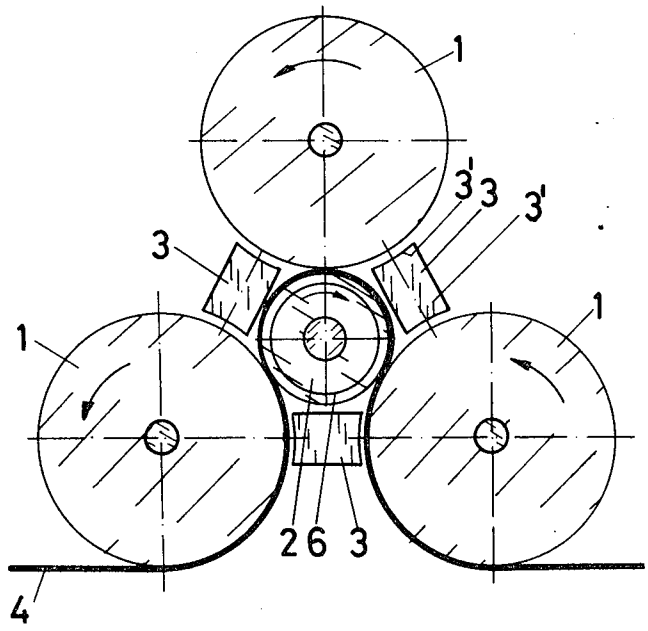
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Primary Examiner—Edward L. Roberts
Attorney—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

Means for the surface treatment of material moved between a plurality of rollers exerting a pressure onto each other under the action of magnetic forces. One form has at least two rollers having peripheries of magnetizable material and has first and second magnet portions associated with each for pulling or attracting the rollers into peripheral engagement with at least one calender or counterroller which may be of any desired peripheral material, with the resultant of the component magnetic attractive force between each of the rollers of magnetizable material and the respectively related magnet bodies lying in a plane passing through the axes of the rollers of magnetizable material and said counterroller. Another form has at least three rollers with magnetizable peripheral material and between which rollers there are magnet bodies arranged to exert magnetic attractive forces on the rollers to engage with at least one counter roller disposed inwardly thereof and providing a magnetic field closed by the said rollers of magnetizable material.

8 Claims, 20 Drawing Figures



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SHEET 01 OF 11

Fig. 1

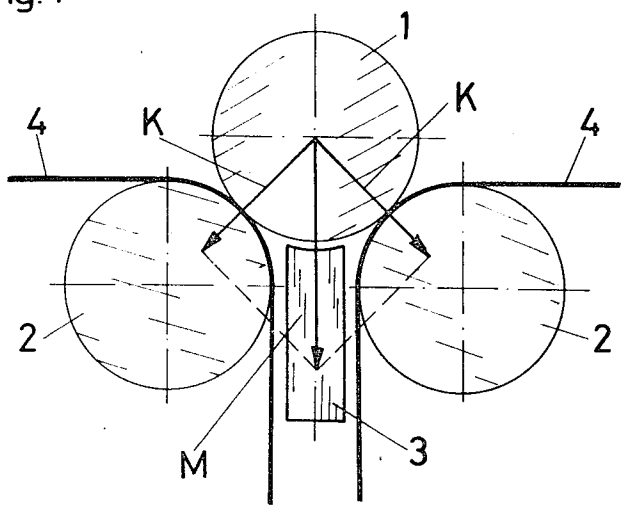
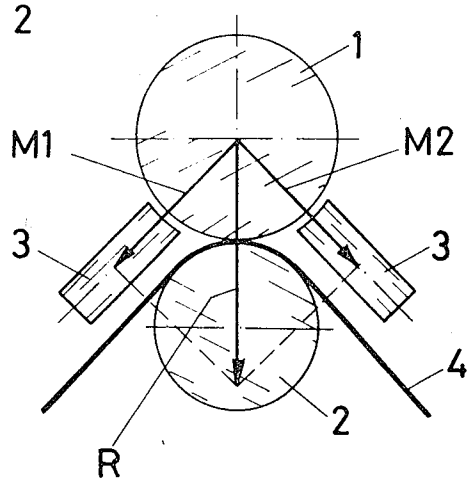


Fig. 2



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Fig. 3

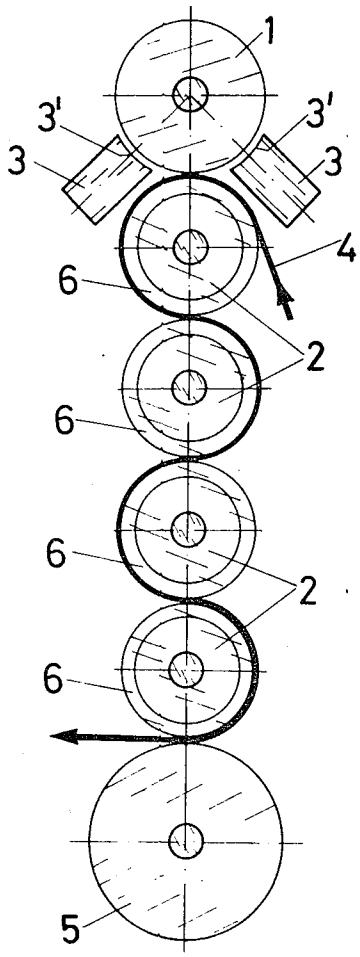
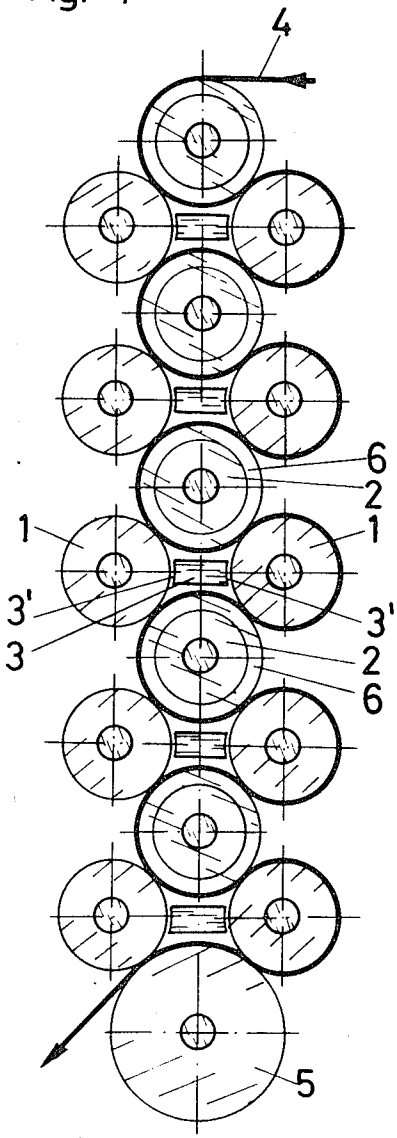


Fig. 4



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Fig. 5

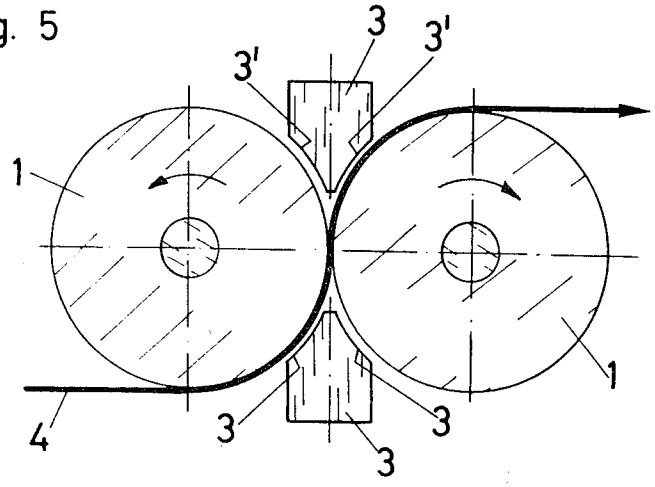
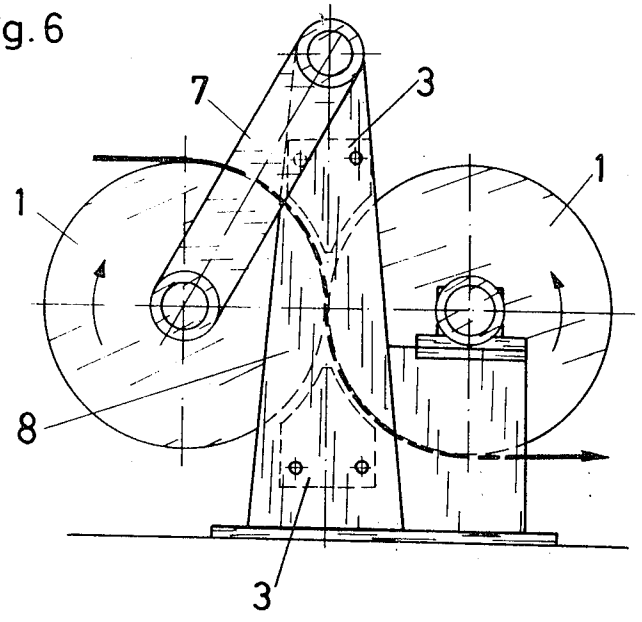


Fig. 6



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Fig. 7

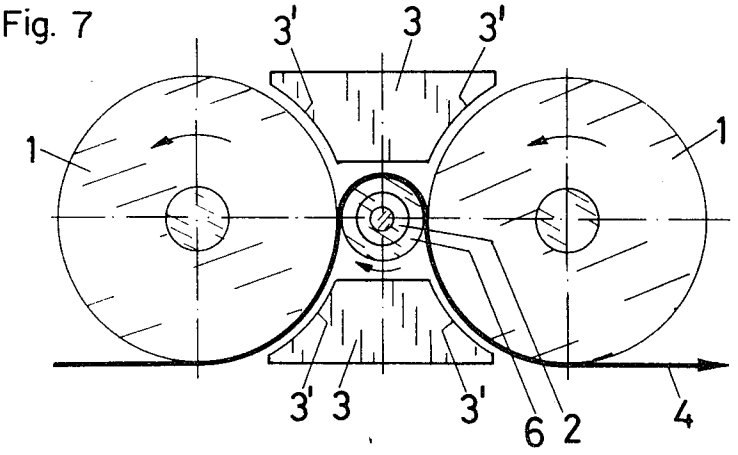
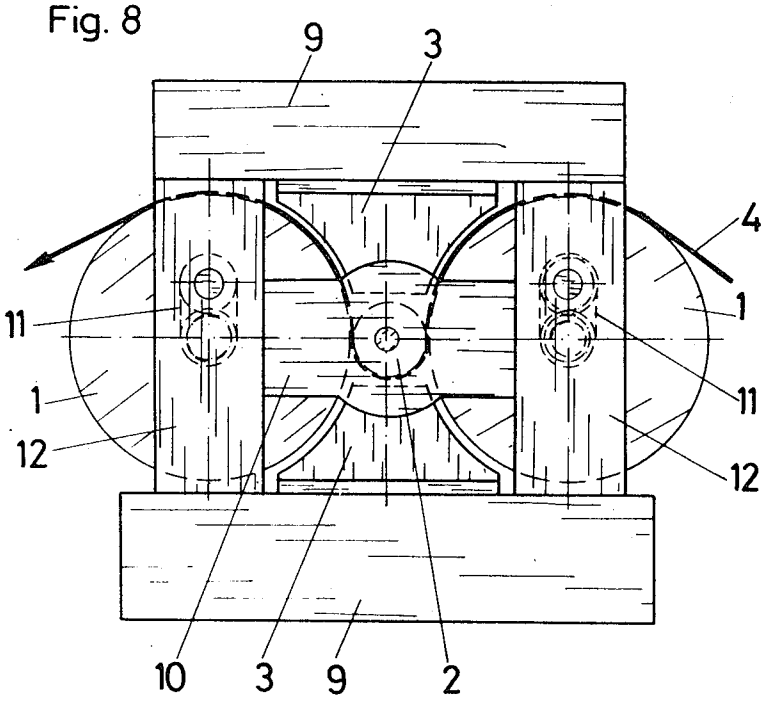


Fig. 8



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Fig. 9

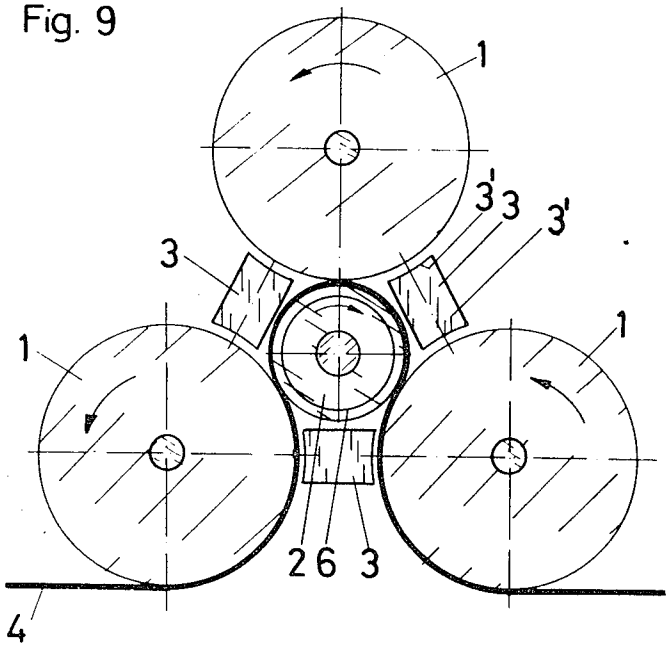
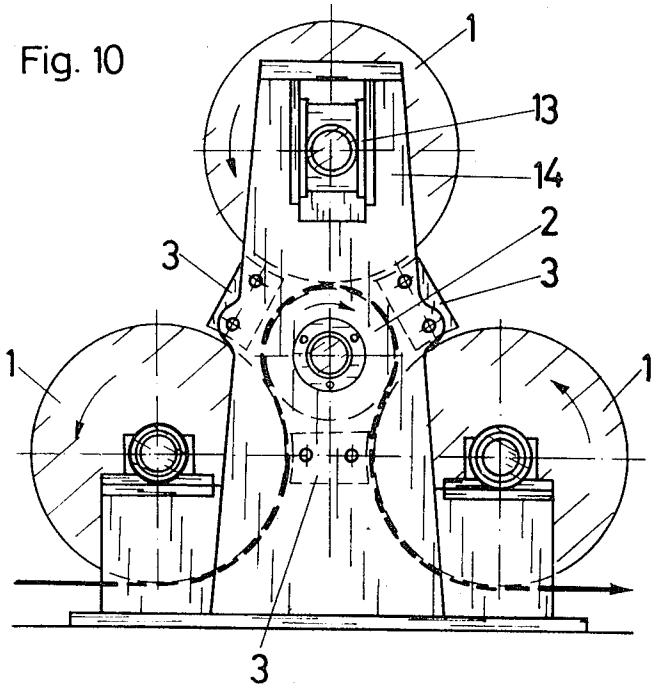


Fig. 10



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Fig. 11

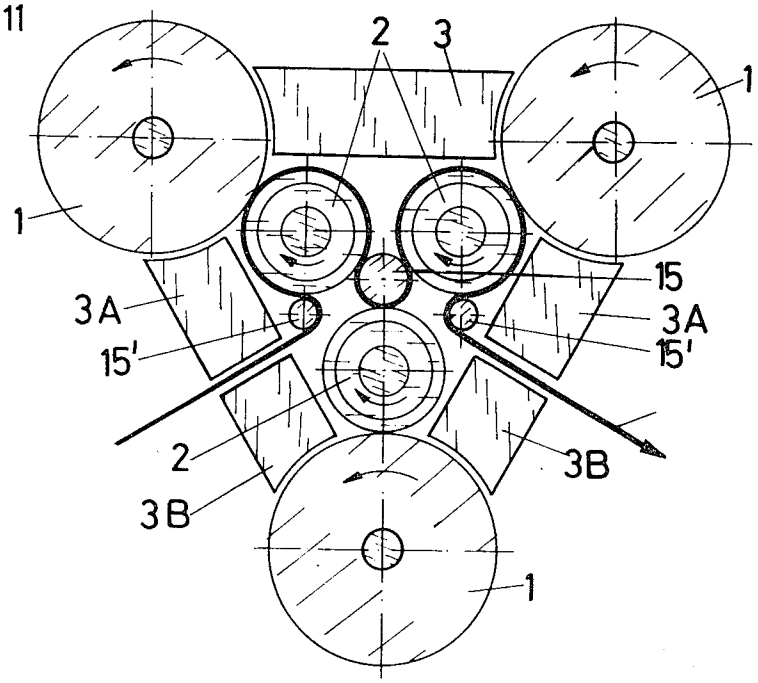
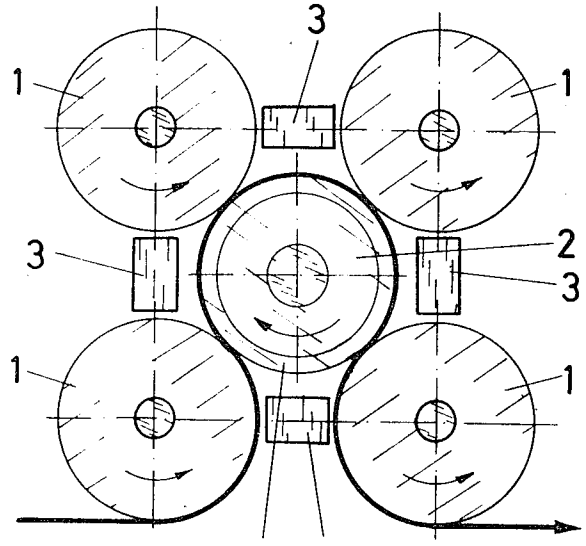


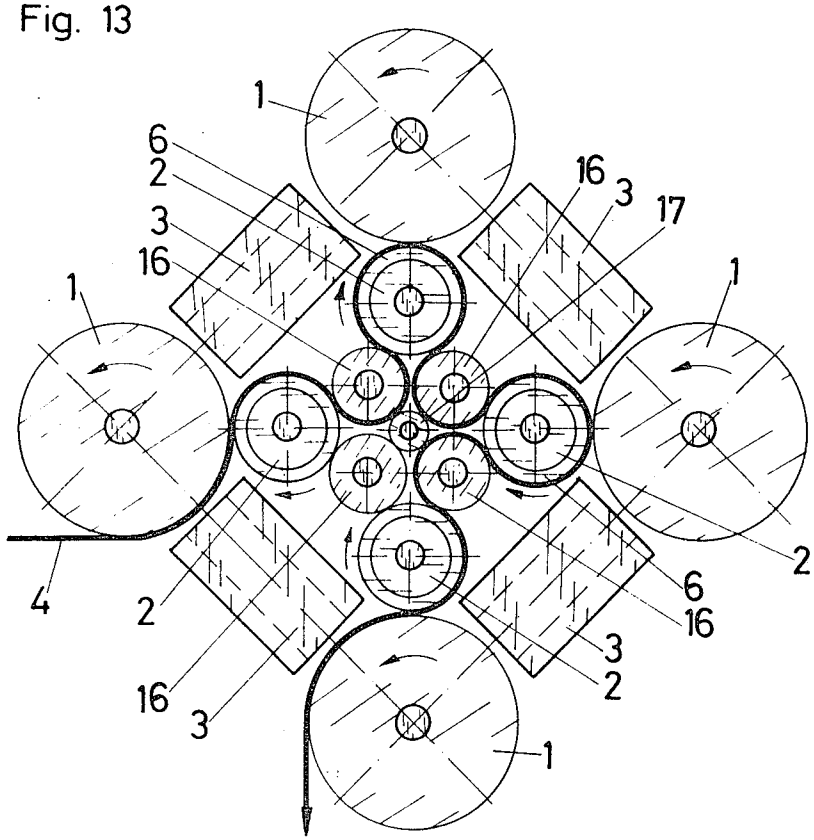
Fig. 12



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Fig. 13



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Fig. 14

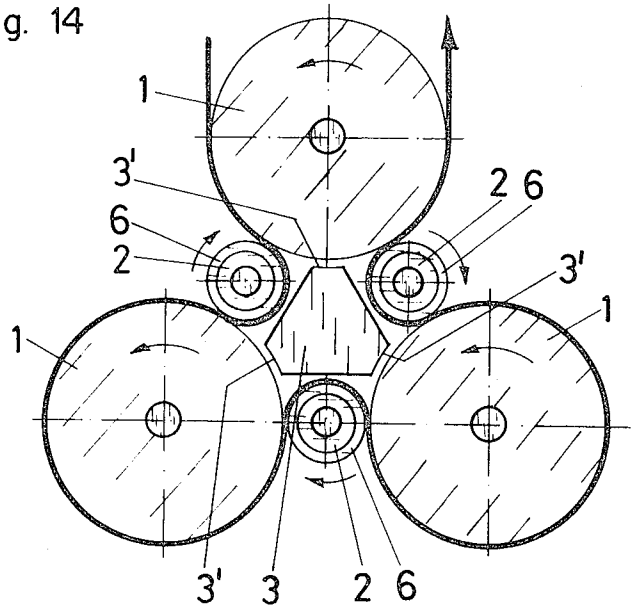
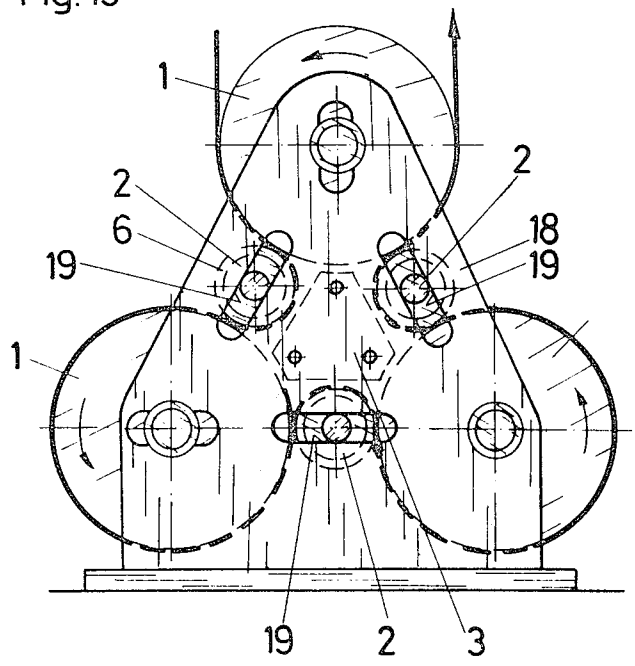


Fig. 15



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Fig. 16

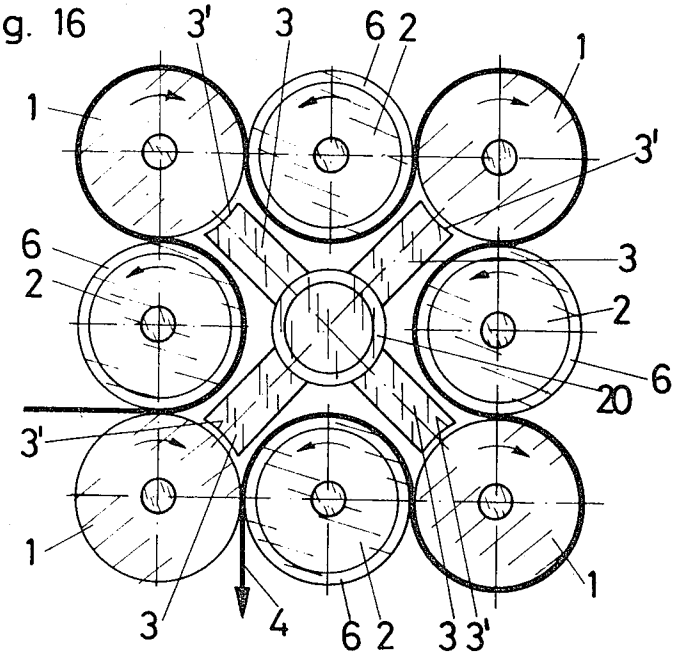
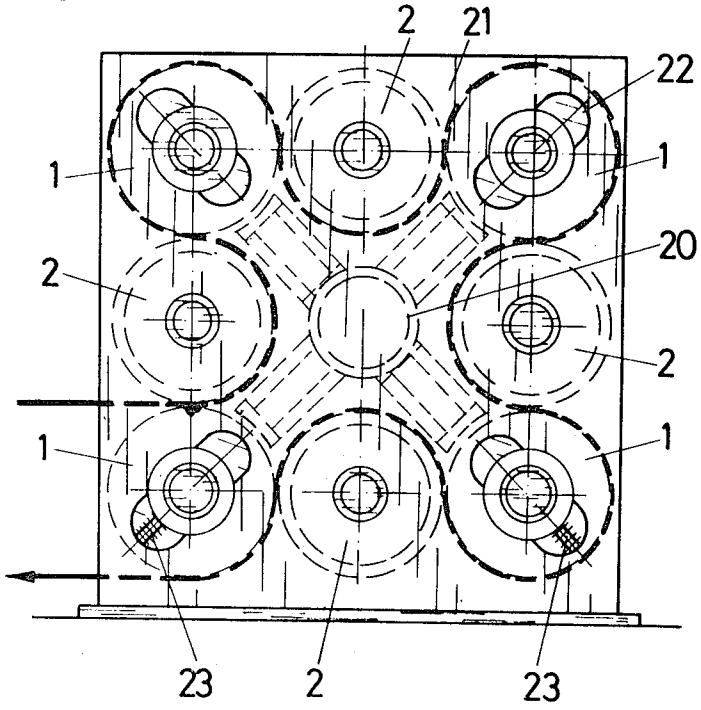


Fig. 17



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Fig. 18

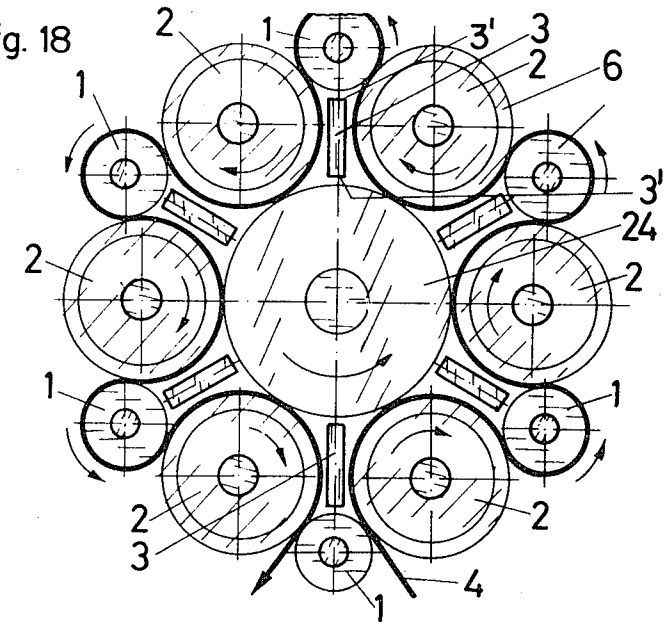
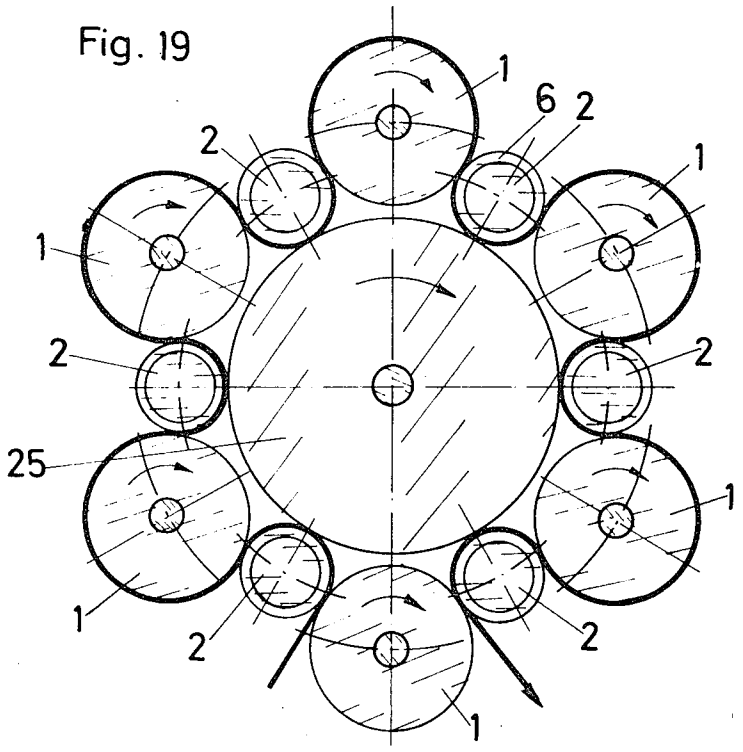


Fig. 19



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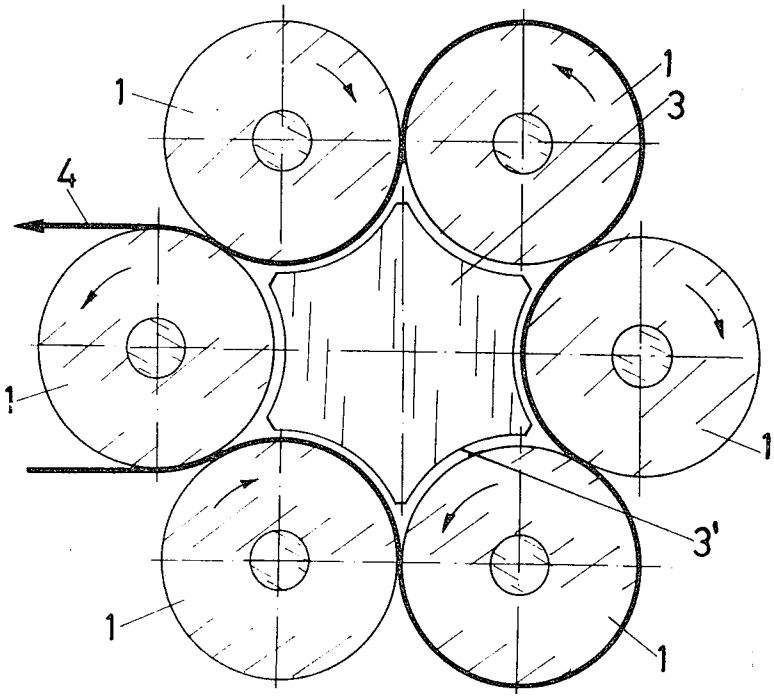
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Fig. 20



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DEVICE FOR SURFACE TREATMENT OF MATERIAL

This invention refers to a device for surface treatment of material, said device being moved between rollers exerting a pressure on each other under the action of magnetic forces. Calenders are preferred examples of such devices.

In order to eliminate the difficulties arising in paper and textile industry in the case of normally weight-loaded calenders and great working breadths, magnet calenders have been proposed showing a regular line pressure. In this case a roller of magnetizable material, e.g., a steel roller, is pulled by a magnet roller and the material to be treated is passed between one or more of such pairs of rollers.

It is a special advantage that magnet calenders of this kind do not show any deflection of the rollers because they pull each other and thus produce a regular line pressure over the whole working length.

It is a shortcoming in these magnet calender constructions that two rollers having a hard surface act upon each other and that the material to be treated lies in the magnetic field between the two rollers pulling each other and therefore forms a more or less large gap; the latter causes an important magnetic loss when it is overcome. Such magnet calenders are only adapted for small material thickness and material which are to be treated with hard rollers from both sides.

In most cases of the use of calenders, a roller having a hard surface, e.g., a roller of steel, is to be followed by a roller having a soft surface, e.g., a roller coated with paper, rubber or plastics material. If a magnet roller directly acted upon such a coated calender roller, important losses would occur, because the coating of the one roller corresponds to a gap from the magnetotechnical viewpoint. As a result—especially in the case of larger material thicknesses—the desired amounts of pressure are hardly achieved. This is especially true when permanent magnet rollers are used since their power is restricted. In the case of electromagnets and high powers, however, a high development of heat and therefore a difficult cooling problem occur.

It is an object of the invention to create a system of bodies acting upon each other by magnetic forces wherein, without important magnetic losses, roller having a relatively soft surface can be used and can be pressed onto similar rollers or rollers having a hard surface.

According to the invention these shortcomings are eliminated in that at least one the rollers is of magnetizable material and at least one magnet body pulling this roller is provided, the roller of magnetizable material supporting on at least one backup counterroller (calender roller) of any desired material and a component or the resultant of the magnetic attractive force lies between the roller of magnetizable material and the one or more magnet bodies in direction of the straight line connecting the axes of the roller of magnetizable material on the one hand and the counterroller (calender roller) on the other.

The roller of magnetizable material can be a solid steel roller or a roller having a steel surface and any desired core. Conveniently the one or more magnet bodies are magnet bars, especially the unilaterally acting, bar-shaped magnet bodies having the form of carriers resistant to bending of equal solidity. The preferably bar-shaped magnet bodies may consist of electromagnets or permanent magnets and shall also be adjustable in the latter case. The counterrollers or calender rollers may have any desired coating corresponding to the purpose of use, they may especially be rollers having a soft surface. The distance of the calender rollers shall be variable and adjustable to the preset material thickness.

The system according to the invention of bodies acting upon each other by magnetic forces may be arranged in such manner—and this is a particular advantage of the invention—that the rollers and magnet bodies applied form a closed static system wherein the roller and magnet bodies are only slightly subjected to deflection.

Embodiments of the invention are hereinafter described with reference to the accompanying drawings without being limited to them.

FIGS. 1 and 2 are schematic views of the different basic systems of embodiments of the construction according to the invention. FIGS. 3 to 20 illustrate several embodiments derived from these basic systems; FIGS. 3, 4, 5, 7, 9, 11, 12, 13, 14, 16, 18, 19, 20 are schematic views and FIGS. 6, 8, 10, 15, 17 are side views of practical solutions. FIGS. 5 and 6, 7 and 8, 9 and 10, 14 and 15, 16 and 17 belong together.

FIG. 1 illustrates schematically a simple basic system wherein the contact pressure between a roller 1 of magnetizable material (which is usually a steel roller having a hard surface) and two rollers 2 of any desired material (usually having a soft surface) is produced, each, by one component K of the magnetic attractive force M between one magnet body 3 and the roller 1 of magnetizable material. The material to be treated 4 is passed between the roller 1 and the rollers 2; thus it is not passed by the magnetic field which is formed between the magnet body 3 and the roller 1. Thus the material thickness does not influence the amount of force between the rollers 1 and 2, when a thicker or thinner material 4 is treated.

FIG. 2 illustrates another basic system wherein the contact pressure between a roller 1 of magnetizable material (which usually is a steel roller having a hard surface) and a roller 2 (usually having a soft surface) is produced by the resultant of the magnetic forces M_1 and M_2 between the magnet bodies 3 on the one hand and the rollers 1 on the other. The material 4 to be treated is passed between the roller 1 and the roller 2; thus again it is not passed by the magnetic field which is formed between the magnet bodies 3 on the one hand and the roller 1 on the other. Thus the thickness of the material has no influence, either, on the amount of the force between the rollers 1 and 2.

Numerous variants of enlarged systems may be derived from these two simple basic systems as is hereinafter shown in the embodiments.

FIG. 3 is a schematic view of a calender wherein a plurality of rollers 1, 2, 5 are superposed in a vertical row in the usual way. The material 4 to be treated passes through all roller slots from the top to the bottom. The rollers 1 and 5 are smooth steel rollers, i.e., rollers having a hard surface, whereas the rollers 2 have a soft coating 6 and thus a soft surface. Only two magnet bars 3 whose pole faces 3' are formed in such manner that, adapted to the roller, they only form a very small gap, act upon the topmost roller 1. Preferably the magnet bars 3 are magnetized over their whole breadth (parallel to the roller axes) in such manner that the magnetic flux is closed by the roller 1 over the gap. The roller 1 is pulled by the two magnet bars 3 and is subjected to a resultant pressure perpendicularly to the bottom, which acts in all roller slots lying thereunder and is regular over the whole breadth of the rollers. In this arrangement the magnet bars 3 and the roller 5 are subjected to deflection and must therefore be sufficiently resistant to bending.

The calender schematically shown in FIG. 4 shows a plurality of rollers 2 superposed at a distance in a vertical row which have a soft coating 6. The bottommost roller is a steel roller 5. A magnet bar 3 is provided between each of the rollers 2 or 5. These magnet bars 3 pull steel rollers 1 into the gap between the rollers 2 or 5. In this case the magnetic force between the magnet bars 3 and the steel rollers 1 has components lying in direction of the straight line connecting the axes of the steel roller 1 on the one hand and the soft calender rollers 2 or the bottommost steel roller 5 on the other hand. Thus the steel rollers 1 produce a pressure onto the material 4 at the contact lines with the soft calender rollers 2 or the roller 5. Preferably this calender is provided with a device which permits adjustable variance of the distance of the rollers 2 and the magnet bars 3 in accordance with the material thickness so that the gap between the pole faces 3' of the magnet bars 3 and the steel rollers 1 remains constantly small. In the case of the embodiment according to FIG. 4 the steel roller 5 and the topmost roller 2 are subjected to deflection and must therefore be sufficiently resistant to bending.

FIG. 5 is a schematic view of a roller press wherein two steel rollers 1 and two magnet bars 3 in the roller slots are provided. These two magnet bars 3 pull the steel rollers 1 over a gap which is larger than the thickness of the material 4. The attractive forces between the pole faces 3' of the magnet bars 3 show a resultant which presses the two steel rollers 1 onto each other. In this arrangement there are no bending stresses on the steel rollers 1 and only small bending stresses on the magnet bars 3. Therefore the magnet bars 3 are to be resistant to bending accordingly.

FIG. 6 is a side view of a practical embodiment of the roller press shown merely schematically in FIG. 5. One of the two steel rollers 1 is firmly mounted at the end of a swivel arm 7. The magnet bars 3 are mounted at the front sides on the side plates 8 of the frame.

FIG. 7 is a schematic view of a roller press wherein a roller 2 having a coating 6 is arranged between two steel rollers 1. The steel rollers 1 are pulled by the magnet bars 3 over a gap which is larger than the thickness of the material 4. The magnet forces between the pole faces 3' of the magnet bars 3 and the steel rollers 1 show a resultant by which the steel rollers 1 are pressed against the roller 2. In this case, too, merely the magnet bars 3 are subjected to deflection and must be sufficiently resistant to bending. FIG. 8 shows a practical embodiment of the roller press schematically shown in FIG. 7. The magnet bars 3 are mounted on strong ground—and overhead beams 9. The roller 2 is stationarily mounted on the side plates 10 of the frame, whereas the steel rollers 1 are mounted on bearing levers 11 which are rotatably mounted on the side plates 12. If the lower magnet bar 3 is solely used, the pressure on the material 4 is increased relative to the lever transmission.

In the roller arrangement schematically shown in FIG. 9 three steel rollers are arranged in a triangle, a magnet bar 3 being arranged between two steel rollers 1, the pole faces 3' of said magnet bars turned to the steel rollers 1 lying symmetrically to the connecting planes of the roller axes. A further roller constituting a backup counterroller 2 having a coating 6 is arranged in the center of the roller arrangement. The magnetic forces acting between the steel rollers 1 and the magnet bars 3 show a resultant action for each of the steel rollers 1, pressing the steel rollers 1 onto the central counterroller 2.

As the material 4 passes through two of the gaps between the magnet bars 3 and the steel rollers 1, these gaps have to be larger than the thickness of the material 4. The arrangement according to FIG. 9 shows a closed static system wherein neither the rollers nor the magnet bars are subjected to deflection. FIG. 10 shows a practical embodiment of the calender schematically shown in FIG. 9. The lower steel rollers 1 and the central roller 2 are firmly mounted on the frame. The upper steel roller 1 is mounted in vertically movable guide bearings 13 which are provided on two opposite side plates 14. The magnet bars 3 are mounted at the front sides on the side plates 14.

FIG. 11 is a schematic variant of the calender arrangement according to FIG. 9 wherein, instead of only one central roller 2, three rollers 2 are arranged in the space enclosed by the steel rollers 1 and the magnet bars 3 or 3A and 3B, which support on the steel rollers 1 on the one hand and on a central steel roller 15 on the other. Furthermore, two of the magnet bars are divided into two partial bars 3A and 3B. Thus the material 4 is introduced through the gap between the one pair of partial bars 3A and 3B and is removed through the gap between the other pair of partial bars 3A and 3B. The thin rollers 15' are pure reverse rollers. In the gap between the partial bars 3A and 3B a magnetic field is formed in such manner that the two partial bars 3A and 3B as well as the undivided magnet bar 3 form a unit. This system like that according to FIG. 9 is in static balance.

FIG. 12 shows a further variant of FIG. 9. Four steel rollers 1 arranged in a square are provided between which the magnet bars 3 are arranged in the connecting planes of the roller axes. In the center a roller 2 having a soft coating 6 is provided. As can be seen from FIG. 13, the four steel rollers 1 can also be arranged in a square standing on top; inside the space enclosed by the steel rollers 1 and the magnet bars 3 a plurality of rollers are arranged: the rollers 2 which touch the steel rollers 1, the rollers 16 lying between the rollers 2 and the roller 17 in the center. The resultants of the magnetic forces between the steel rollers 1 and the magnet bars cause a pressure of the rollers 2 directed to the center, whereby the roller 16 are pressed towards the center, i.e., towards the roller 17 arranged there. In this arrangement the material 4 is subjected to a pressure on numerous roller slots. The arrangement according to FIG. 12 as well as that of FIG. 13 shows a system in static balance without being subjected to deflection.

In the embodiment according to FIG. 14 three steel rollers 1 are provided in triangle which—in contrast with the preceding embodiments—are pulled by a central magnet bar 3 or by its pole faces 3' radially to the center of the system. The steel rollers 1 support on the rollers 2 having a coating 6. Between the steel rollers 1 and the rollers 2, a pressure acts, which is a component of the attractive force between the steel roller 1 concerned and the pole face 3' of the magnet bar. The axes of the rollers 2 lie in the connecting plane of the axes of the adjacent steel rollers 1. In this arrangement neither the magnet bars 3 nor the rollers 1 and 2 are subjected to deflection.

FIG. 15 is a practical embodiment of the arrangement schematically shown in FIG. 14. The frontal sides of the central magnet bar 3 is firmly mounted on the side plates 18 of the frame. Furthermore, the right lower steel roller 1 is firmly mounted in the side plates 18. The other two steel rollers 1 and the rollers 2 are adjustably mounted in slots 19 of the side plates 18.

In the embodiment according to FIG. 16 four magnet bars 3 are arranged in crossshape. Four steel rollers are pulled by the pole faces 3' of the magnet bars 3 and are pressed towards the rollers 2 having a coating 6 under the action of a component of this attractive force. The four magnet bars 3 are seated on a common carrier 20. In the system according to FIG. 16 neither the rollers 1, 2 nor the magnet bars 3 are subjected to deflections.

FIG. 17 shows a practical embodiment of the arrangement schematically shown in FIG. 16. The carrier 20 of the magnet bars is frontally mounted on the side plates 21. The rollers 2 are firmly mounted in these side plates 21. The steel rollers 1, however, are adjustably mounted in slots 22, the two lower steel rollers having a weight relief by springs 23 (or by pneumatically or hydraulically admitted pistons).

FIG. 18 shows an embodiment wherein a plurality of rollers 2 having a coating 6 are arranged around a central roller 24 of magnetizable material. Between the rollers 2 magnet bars 3 are provided which act on both sides, e.g., having pole faces 3' projecting outside and inside. These magnet bars 3' acting on both sides pull the steel rollers 1 over a small gap which produce a regular pressure towards the coated rollers 2 over the material breadth, whereby the rollers are supported on the central roller 24, which keeps the whole system in balance. All rollers can be radially adjusted in accordance with the thickness of the material 4. The steel rollers 1 can also be exchanged in such manner that the gap between the latter and the magnet bars 3 remains the same, even if strong material 4 are to be treated.

The arrangement according to FIG. 19 also shows a central roller. However, this central roller is a magnet roller 25 which is used in this embodiment instead of the bar-shaped, not rotating magnet body of the other embodiments. A plurality of steel rollers 1 is arranged around the magnet roller 25 which are pulled by the magnet roller 25, but do not touch the latter. Between the steel rollers 1, rollers 2 having a coating 6 are arranged. By the action of the magnetic force between the central magnet roller 25 and the steel rollers 1 the latter are pressed towards the rollers 2 and those towards the surface of the magnet roller 25. In principle, the inversed case is also possible: the central roller is a roller of magnetizable material (steel roller) and peripheric magnet rollers are inserted instead of the rollers 1.

In the embodiment according to FIG. 20, a central, nonrotating magnet bar 3 is provided, having a plurality of pole faces 3' to which a corresponding plurality of steel rollers 1 having a gap are opposed. According to the essential feature of the invention, the pressure onto the material 4 to be treated is not directly exerted between the magnet body (magnet bar 3) and one of the rollers pulled by the magnet body (steel rollers 1), but between two of the steel rollers 1 which are pressed towards each other by a component of the attractive force between the magnet bar 3 and the steel rollers 1.

The following remarks are added to the embodiments described which are not limited to this number within the scope of the invention.

The rollers 1 which, in all embodiments, are described as being pulled by the magnet bodies 3, 3A, 3B, 25 directly over a small gap, consist of magnetizable material; usually they are solid steel rollers or rollers comprising a steel surface. On the contrary, those rollers towards which the rollers 1 are pressed by a component or resultant of the magnetic attractive force, can be of any desired material. With the exception of the embodiments according to FIGS. 5 and 6 and FIG. 20, these are the rollers 2 having a coating 6 of any desired, usually soft material and any desired surface. In the embodiments according to FIGS. 5 and 6 and FIG. 20, those rollers towards which the rollers 1 pulled by the magnet body are pressed, are also of magnetizable material which, in their turn, are pulled by a magnet body; these two rollers 1 are also pressed to each other, i.e., under the action of a component of the direct magnetic force. This pressure of the rollers 1 towards the rollers 2 or the rollers 1 between each other is the essential feature of the invention, which can be described as i n d i r e c t magnetic pressure.

In most embodiments the magnet bodies are magnet bars 3. They are bar-shaped magnet bodies extending over the machine breadth (material breadth) consisting usually of a plurality of single magnets following each other in direction of the machine breadth (material breadth), the pole or pole shoes (N, S) of alternately different polarity of said single magnets projecting into the pole faces 3'. Preferably, the used magnet rollers (e.g., the magnet roller 25 of the embodiment according to FIG. 20) will also have alternately different polarity in direction of the machine breadth (material breadth) on their surfaces.

The magnet bodies may consist of electromagnets or of permanent magnets.

In the embodiments described the axes of the rollers are horizontal. The described systems may also be realized having vertical roller axes; thus the weight of the rollers is practically merely determined by the magnet forces acting in the system, without any influence onto the forces.

What I claim is:

1. A calender device for the surface treatment of elongated material passing between rollers exerting a pressure onto each other under the action of magnetic forces comprising in combination:

a. a plurality of at least two rollers each having a periphery of magnetizable material and means for supporting them for rotation about their respective axes which are generally disposed in parallel;

b. at least one calender backup or counterroller having a central axis disposed in parallel with the axis of said roller of magnetizable material, so as to essentially operatively engage peripherally with said two rollers of paragraph (a) during treatment of material passing between said latter rollers;

c. a plurality of first and second magnet means disposed adjacent each of said rollers of paragraph (a) and exerting a magnetic attractive force to bias said first-mentioned rollers of paragraph (a) toward said counter roller of paragraph (b); and

d. said magnet means of paragraph (c) disposed relative to said rollers of paragraph (a) so that a resultant of the component magnetic forces acting between said each of said rollers and said related magnet means lies in a plane passing through the axes of said respective rollers and said counterroller.

2. A calender device for the surface treatment of elongated material passing between rollers exerting a pressure onto each other under the action of magnetic forces comprising in combination:

a. a plurality of at least three rollers, each having a periphery of magnetizable material and means for supporting them for rotation in equal spaced-apart relation about their respective axes which are generally disposed in parallel;

b. at least one calender backup or counter roller having a central axis disposed centrally relative to and in parallel with the axis of said rollers of magnetizable material, so as to essentially operatively engage peripherally therewith during treatment of material passing between said rollers of paragraph (a);

c. first and second magnet means disposed adjacent each of said rollers of paragraph (a) and providing a generally concentric arrangement of said rollers and magnet means, and exerting a magnetic attractive force to bias said first-mentioned rollers of paragraph (a) toward said counterroller of paragraph (b) and in a generally peripheral direction toward one another; and

d. said magnet means of paragraph (c) disposed relative to said rollers of paragraph (a) so that a resultant of the component magnetic forces acting between said each of said rollers and said related magnet means lies in a plane passing through the axes of said respective rollers and said counterroller.

3. A device according to claim 2 further including means for adjusting the distances of said rollers of paragraph (a) relative to said counterroller to better accommodate the particular thickness of the material to be treated.

4. A device according to claim 2 wherein said magnet means comprise nonrotating magnet bars having opposite pole faces and extending generally over the breadth of the calender device, and together with said rollers of paragraph (a) form a closed static system.

5. A device according to claim 4 wherein some of said magnet bars have a dividing slot between the opposite pole faces, and disposed generally opposite to each other for the passage of the material therethrough treatment, and the inner magnet field of each magnet bar acting across the dividing slots.

6. A device according to claim 2 wherein a plurality of counterrollers corresponding in number to at least the number of rollers of paragraph (a) are arranged in parallel within the space enclosed by said rollers of magnetizable material and said magnet means; and each counterroller being essentially in operative rotating peripheral contact with a corresponding roller of paragraph (a).

7. A calender device for the surface treatment of elongated material passing between calender rollers exerting a pressure onto each other under the action of magnetic forces comprising;

a. a plurality of at least three rollers having outer peripheries of a magnetizable material and means for supporting said rollers in equally spaced-apart peripheric relation with the respective axes parallel and for relative rotation in the same direction;

b. at least one counterroller having an axis disposed parallel to and at least generally between at least two of said axes of said rollers of paragraph (a), and with the periphery of said counterroller being essentially in operative rotating contact with at least one of said rollers of paragraph (a);

c. magnet means exerting magnetic attractive forces upon said rollers of paragraph (a) so that a resultant of said magnet attractive component force between each roller of paragraph (a) and said related magnet means lies in a plane connecting the respective axis of at least one of said rollers of paragraph (a) and that of said counter roller.

8. A device according to claim 7 wherein a plurality of counterrollers corresponding in number to at least the number of rollers of paragraph (a) are arranged in parallel within the space enclosed by said rollers of magnetizable material and said magnet means; and each counterroller being essentially in operative rotating peripheral contact with a corresponding roller of paragraph (a).

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