(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 046 175**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **81104941.0**

(22) Date of filing: **25.06.81**

(51) Int. Cl.³: **B 05 B 5/08**, B 05 D 1/04

(30) Priority: **19.08.80 US 179535**

(43) Date of publication of application: **24.02.82 Bulletin 82/8**

(84) Designated Contracting States: **DE FR GB NL SE**

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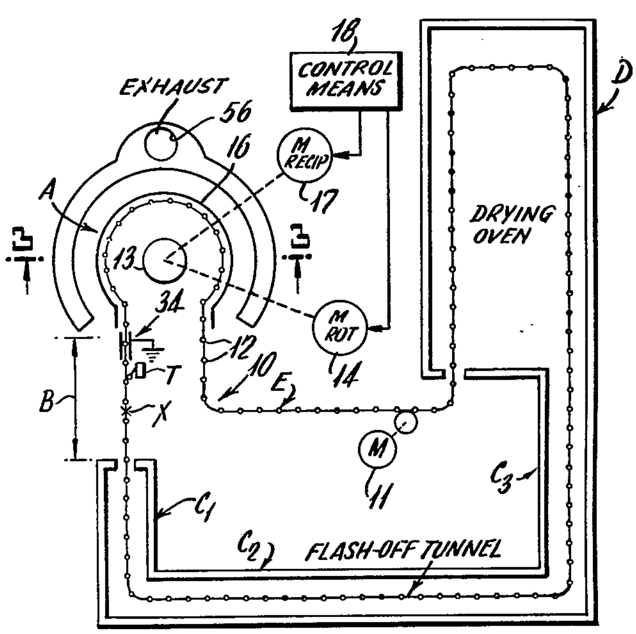
(54) **Elastomeric-coated roll and method and apparatus for making the same.**

(57) The invention contemplates a thin and uniformly applied elastomeric coating for a cylindrical roll, in mass-produced volume. A succession of like vertically oriented cylindrical rolls (12) is conveyed along an endless path of movement (10) which includes a segment (A) that is cylindrically arcuate about a vertical axis of electrostatic spray-disc rotation. A solvent mixture of elastomeric-ingredient material is continuously applied to the rotating disc (B) while the latter is vertically oscillated over the length of the rolls (12) and while the rolls (12) in the segment (A) are continuously rotated about their individual axes. The path of movement includes a course which leaves the segment and later rejoins the segment, after passage through a zone of partial curing, the cycle being repeated for multiple-pass building to desired coating thickness.



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Background of the Invention

The invention relates to elastomeric coating of cylindrical rolls.
Elastomeric coatings have been applied to rollers for many years, using a variety of techniques. Typical of these techniques are:

(1) Compression or transfer molding.
(2) Hand lay-up of calendered stock.
(3) Radial extrusion.
(4) Longitudinal extrusion.
(5) Injection molding.

These techniques have all worked well, but generally had the detriment of requiring a minimum of 0.030-inch coating thickness, in order to be functional from a process standpoint.

There are many end-use applications for rollers where a thick coating is either not required or is detrimental. Such applications include:

1. Applications where a greater friction coefficient is required than can be attained with bare metal.
2. Applications where an extremely small, but controlled, nip between mating rolls is required.
3. Applications where sound deadening is required, without significantly affecting apparent hardness of a bare metal roll.
4. Applications that require a thin elastomeric coating as a barrier to chemical attack, without significantly lowering apparent hardness.
5. Applications that require a thermal barrier without significantly affecting apparent hardness.

In addition, situations arise where elastomeric coatings on rollers are required but are not necessarily restricted by coating thickness, as for example in situations wherein production-rate restriction is imposed by the fact that a particular core does not lend itself to high production rate methods such as molding, or that production volumes are too large for economic use of methods such as hand lay-up extrusion. We are unaware of any existing high-volume technique capable of coating in thin-wall thicknesses in the range of 0.005 to 0.012 inch, on any type core that is electrically conductive.

In the last 20 years, there has been much progress in the application of paint to such substrates as car bodies, furniture and containers, by spraying in solution form. Air-pressurized atomization was improved by electrically charging the solution at the point of atomization and by grounding the substrate to be coated; this improved technology is described in patents to Ransburg Corporation in the 1960's, and as a result coating efficiency improved, meaning less wastage of material. Ransburg further determined that pressure atomization was not required, since atomization could be obtained by having like-charged particles repel each other, as in the Ransburg continuous coating, revolving electrostatic disc.

Pressure atomization in the spray coating of elastomeric systems has been successfully used for very thin coatings, in the range 0.001 to 0.003 inch, but it has been found lacking as a coating technique for coats in the thickness range of 0.005 to 0.012 inch, for reasons of poor thickness uniformity. The technique also exhibits the same detriment as in paint application, namely, excessive material wastage. This wastage is particularly serious when using expensive elastomers, such as polyurethanes, polysiloxanes, and fluoroelastomers.

Brief Statement of the Invention

It is an object of the invention to provide an improved technique for spray-coating with elastomeric materials.

A specific object is to provide such a technique which can produce uniform coating thickness in the thickness range up to about 0.030 inch.

Another specific object is to provide such a technique which lends itself to high-volume productivity, with high coating efficiency and consequent low material wastage.

A further object is to provide such a technique which is adaptable to both liquid and solid elastomers, and which is reproducible as to product quality.

A general object is to meet the above objects with a technique and apparatus which is applicable to a variety of roller-core constructions and dimensions, and with lower tooling cost than normally required.

The invention achieves the foregoing objects and other features, in the specific context of elastomeric coating of cylindrical rolls, by conveying a succession of like vertically-oriented cylindrical rolls along an endless path of movement which includes a segment that is cylindrically arcuate about a vertical axis of electrostatic spray-disc rotation. A solvent mixture of elastomeric-ingredient material is continuously applied to the rotating disc while the latter is vertically oscillated over the length of the rolls and while the rolls in the segment are continuously rotated about their individual axes. The path of movement includes a course which leaves the segment and later rejoins the segment, after passage through a zone of partial curing, where a major fraction of the solvent is evaporated, prior to recycled entry into the segment for receiving the next increment of coat application.

Detailed Description

The invention will be described in detail for certain illustrative specific product samples, involving use of apparatus shown in the accompanying drawings, in which:

Fig. 1. is a simplified plan-view diagram, schematically indicating an endless conveyor and other components of an electrostatic-coating system of the invention;
Fig. 2 is an enlarged vertical sectional view of a cylindrical-roller core to be elastomer-coated, shown supported by accessory components for transport in the conveyor of Fig. 1;
Fig. 3 is a simplified vertical-section diagram, taken generally at 3-3 in Fig. 1, to schematically indicate relationships within the spray-coating region of Fig. 1;
Fig. 4 is a simplified view in elevation of a roller-suspension part of the system of Fig. 1; and
Fig. 5 is a diagram to graphically display one component of displacement motion involved in operation of the system of Fig. 1.
In the generally plan-view diagram of Fig. 1, a conveyor 10 comprises an endless loop of articulated links, continuously driven by motor means 11. Small circles 12 at equal spacing along the

conveyor 10 will be understood to designate like cylindrical rollers, sometimes referred to as roller cores 12. In a coating zone A, these rollers are coated by a centrifugally discharged, electrostatically charged spray or mist of a solvent mixture of elastomeric material, such spray or mist issuing from a continuously rotating disc 13, driven by motor means 14, within an arcuate spray-booth region having an outer wall 15. Within the zone A, conveyor 10 guides the suspended rollers 12 along an arcuate path which lies in a horizontal plane and which extends a major fraction of a full circle about the rotary axis of disc 13, placing the suspended rollers at substantial radial offset from disc 13. As will be later described in detail, each roller suspension system provides for driven rotation of the roller about its individual suspension axis (namely, the roller axis); this is accomplished by a friction wheel between the suspended roller and the suspension system, the friction wheel engaging an arcuate rub bar 16 while traversing the spray-booth segment of the conveyor path.

A radiating cylindrical volume characterizes the spray or mist discharge from disc 13; this is achieved by means of a cyclical vertical reciprocation of disc 13 in the course of its continuous rotation, the reciprocating period being very much longer than the rotational period. A motor 17 will be understood to provide such reciprocation, and control means 18 serves to regulate both motors 14-17 to assure a desired relationship between reciprocation speed and rotary speed, as may be found best suited for a particular job purpose.

Within the relatively narrow gap between arcuate limits of the spray zone or segment A, entering and leaving portions of the conveyor 10 pass each other on relatively closely spaced parallel courses, communicating with further zones of continuous inspection and treatment. Thus, for rollers 12 which have just been exposed to an increment of spray coating in zone A, a zone B is provided for inspection (and also for coated-product removal, and for uncoated roller-core loading). After passing zone B, the conveyed rollers 12 enter an elongate enclosure, labelled "Flash-Off Tunnel" and comprising zone legs C_1, C_2, C_3. The last of these legs is open to a drying oven, whence the conveyor provides a relatively short exposure zone E, for motor-drive provision and for guided recycling entry into the spray zone A. For a given speed of conveyor travel, the enclosed zones C and D provide such conveyor length as to assure desired extraction of volatiles and substantial curing of the incremental elastomeric coating which results from passage of each roller through the spray zone A.

The conveyor cycle repeats for as many such cured incremental deposits as are specified for a particular job. And the process may be run continously, with full assurance of precisely the same exposure to a plurality of successive full loads of the conveyor 10. For example, in a start-up operation, for an unloaded container, a clearly identifiable brightly painted lug between two adjacent roll-suspension systems on the conveyor 10 may mark a starting point, such as the point labeled X in the loading zone B; and, as the conveyor moves through zone B, the apparatus is loaded with uncoated metal roller cores 12 for all roll-suspension systems following the X-marked location, until the X-marked location re-emerges from zone A. Thereafter, the X-marked location passes through zone B (and preferably, just as it enters zone B), a cycle count is registered, as may be noted automatically by a counter-trip device, schematically suggested at T. When the desired cycle count is reached, each emerging fully coated roller is removed and replaced by a new uncoated roller core, in succession, until all the fully coated rollers have been replaced, the counting means T being reset to enable the same number of incremental coats to be applied to the fresh load of uncoated roller cores.

Further detail of the apparatus of Fig. 1 will appear from description in connection with remaining figures. In Fig. 2, the suspension system for one of the many rollers 12 to be coated appears only to the extent of its suspension hook 20; the roller core 12 will have been preassembled with support elements (to be described), including a central suspension rod 21 having a ring link 22 at its upper end, for easily removable engagement to the suspension hook 20.

For the illustrative situation here presented, the roller 12 is for use as a toner-fusing roll in electrostatic printing equipment. The roller core 12 comprises an elongate metal cylinder 23 of diameter D_1, having a central bore 24, with a counterbore 25 at each end. A mounting hub or end bell 26 is rabbeted to fit each counterbore and to provide a shoulder of diameter to match that of cylinder 23. The bore of each hub 26 is sized for the ultimate mounting-shaft requirements of the end-use machine. The elastomeric coating is to be applied, within close tolerances as to uniformity and thickness, to the external cylindrical surface of the roller assembly 23-26.

Aside from a very thin adhesive layer that may initially have been applied to the roller assembly 23-26, the preparation of roller 12 for coating includes assembly to rod 21, via cylindrical lower and upper masking caps 27-28 of diameter $D_2 \geq D_1$, and retained via a removable pin 29. The lower cap 27 is of length L_1, greater than the length L_2 of upper cap 28. Caps 27-28 are bored and counterbored for non-interference with adjacent hub (26) and rod (21) parts, and at abutment with the outward flange portion of each hub 26, the outer circumferential corner of each of caps 27-28 has a significant chamfer 27' which may be at 45^o but is preferably at substantially 60^o to the radial plane of mask-to-hub abutment, thereby establishing a clearly recognizable discontinuity at the longitudinal limits of the cylindrical surface (diameter D_1). The radial depth ΔR_1 should substantially exceed any radial clearance in the fit of a cap 27 (28) to its adjacent hub 26, in order to assure such recognizable discontinuity.

Fig. 3 is a simplified view taken on a diameter of the cylindrically arcuate path of roller conveyance around the rotary axis of the spray disc 13, and it will be understood that in Fig. 3 the radial offset R_2 between disc 13 and the path of rollers 12 has been deliberately compressed, in order to provide a better illustration of co-operating elements. In general, the mean diameter D_3 of the path of roller movement through the spray segment A may be such as to provide a radial offset R_2 which is approximately the diameter D_4 of the disc 13, but which in any event is large enough to assure against arcing to ground.

In Fig. 3, the disc 13 is shown at the upper limit of its reciprocation cycle, wherein the flat upper surface of disc 13 is at an upper plane of centrifugal discharge, which plane has axially lapped the upper caps 28 of exposed roller-support structures to the extent ΔL_2, being $< L_2$. The lower reciprocated position of the upper surface of disc 13 is shown at phantom outline 13', where said upper surface has similarly lapped the lower caps 27 to the extent ΔL_1, being $< L_1$' the full reciprocating stroke L_R imparted by motor 17 and its associated disc-reciprocating mechanism (suggested at 17' in Fig. 3) is thus the cylindrical length L_3 of a roller, plus the two axial-end overlaps ΔL_1 and ΔL_2.Fig. 5 graphically displays the preferred reciprocation cycle, wherein all axially displaced motion of disc 13 is at substantially uniform speed, therebeing a short dwell of selectively controllable duration between reversing halves of the stroke cycle.

Fig. 3 schematically suggests a suitable supply means 30 for solvent mixture of elastomeric material, to be deposited on disc 13 for the described centrifugal discharge. A nozzle-ended tube 31 will be understood to be elongate and flexible and to be carried with the described vertical-reciprocation motion, described for disc 13. The flexible length of tube 31 will further be understood to be of such extent as not to impair the reciprocation cycle or the fixed orientation of the nozzle end of tube 31 (with respect to rotating disc 13). The supply means may thus be a fixedly mounted tank, equipped with a metering displacement pump 32 for control of the flow of the solvent mixture in tube 31 to its nozzle end.

Further uniformity of droplet formation and droplet dispersion in the spray or mist discharge of disc 13 is developed through electrostatic charging of all droplets, to the same polarized level. In Fig. 3, such charging means comprises a grounded polarizing-voltage source 33, which may be physically outside the spray zone A, and an elongate flexible insulated conductor 34 to brush means 35 having continuous electrical contact with the reciprocated rotating disc 13, it being understood that all reciprocating and rotary drive connections to disc 13 are suitably insulated with respect to the grounding of means 33. The other pole of the electrostatic field is established by grounding the conveyed rollers 12; in Fig. 1, such grounding is schematically suggested at 34, via contact with moving conductive elements of the conveyor 10, at or in the vicinity of zone A. The polarizing sense should be such that a particle-attracting electrostatic field is established to each of the rollers 12 in zone A; therefore, the output polarity of means 33 to brush 35 is negative.

Fig. 4 is a simplified showing of a typical roller-suspension unit 40, constituting one of the endless succession of such elements (each equipped with its hook 20) in the described endless conveyor system 10. A central body 41 is secured at mid-span of an axle 42, the ends of which are equipped with crowned antifriction track rollers 43-43'. Rollers 43-43' have guided rolling contact with opposed C-shaped rail channels 44-44' of the track component of conveyor system 10, the transverse center 45 of symmetry of which will be understood to follow the continuous and endless course described in connection with Fig. 1; the suspended and fixed relation of rail channels 44-44' may be achieved via bracket structure 46 secured to the underside of a suitable base 47 at spaced locations along the endless course. It will be understood that aligned equal-projection arms 48 perpendicular to axle 42 and extending forwardly and rearwardly of axle 42 may be but one unit of an endless chain-like succession of like articulated units, interconnected at the outer ends of arms 48.

Pendulously suspended from body 41, on a horizontal pivot axis 49 through body 41, is a first element 50 from which a second element 51 is suspended for rotation about a generally vertical axis. The second element 51 includes a motion pick-off roll 52 of such diameter D_5 as to slightly interfere with locally fixed positioning of the rub bar or strip 16, and of course the suspension hook 20 is also part of the rotatable element 51. In the indicated circumstances, when roll 52 develops its slight interference with the rub bar 16, the friction of the engagement is such as, by reaction, to drive hook 20 (and a roller suspended therefrom) in continuous rotation, by reason of conveyor movement through the zone A extent of bar 16. Thus, while disc 13 is continuously rotating and is vertically reciprocated, a mist of negatively charged droplets of solvent mixture is being centrifugally and electrostatically induced to deposit upon the continuously rotating cylindrical surface 23 of each roller 12 as it is conveyed through zone A.

The method of the invention will be illuminated by illustrative specific examples.

EXAMPLE I

The product 12 was a toner-fusing roll for use in a xerographic copying machine, wherein the described roller cores 12 had a measured diameter D_1 of approximately 3 inches and length L_3 of approximately 15 inches. They were equipped with a lower masking cap 27 having a length L_1 of 4 inches, and an upper masking cap 28 having a length L_2 of 2.5 inches, being then hung as described from the conveyor system 10. The disc diameter D_4 was 10 inches, and the cylindrically arcuate segmental path of conveyor 10 in zone A was of 36-inch diameter (D_3). Conveyor speed was set at 5.6 feet per minute. The disc-reciprocation stroke and disc position were set for a lower mask overlap ΔL_1 of 3 inches (i.e. 1 inch from the bottom of mask 27) and for an upper mask overlap ΔL_2 of 2 inches (i.e. 1/2 inch below the top end of mask 28.)The rate of reciprocation (Fig. 5) was set at 14 cycles per minute, the lower hesitation or dwell Δt_1 being set at 0.5 second and the upper hesitation or dwell Δt_2 being set at 0.75 second. Disc 13 rotation was set at 1950 rpm, and delivery of solution at 31 was set at 510 cc/min. The size of the motion pick-off rollers 52 was such as to effect approximately twelve revolutions of each workpiece (12) about its own central axis, in the course of its 270° zone-A traverse, in engagement with the rub bar 16.

The solution contained and dispensed from source 30 comprised:

Fluoroelastomer compound ... 18 parts (by weight)
Methyl Ethyl Ketone .... 41 parts (by weight)
Methyl Isobutyl Ketone ...... 41 parts (by weight)

The solution was made using appropriate mixing techniques and tested for viscosity and concentration, being then charged to the dispensing tank 30 and kept under agitation as long as required.

To start the process, solution-metering pumps were started and will be understood to be sufficiently symbolized by the means 32 of Fig. 1; at the same time, the conveyor drive (11), disc rotation (14), and disc reciprocation (17) were started; and a polarizing voltage of 40-kV was applied to the brushes 35 with respect to ground. The parts 12 were conveyed continuously through zone A for a total of 9 (10) cycles, to produce a total coating thickness of 7.5 (8.0) mils, flash-off and curing being accomplished as appropriate, with each conveyed cycle.

EXAMPLE II

Machine settings, voltage stress, roller cores and all Example I factors remained, except for change in the dispensed solution, which comprised:

Liquid Polysiloxane Compound ...	200 parts (by weight)
Toluene	60 parts (by weight)
Methyl Ethyl Ketone	25 parts (by weight)

The resulting product was again a toner-fusing roll, but characterized by a silicone surface produced by the described technique, to substantially the same developed coating thickness as for Example I.

The various machine settings set forth above were arrived at through experimentation to provide the best combination for efficient coating. In the course of such experimentation, it has been determined that coalescing of the solution prior to contacting the surface of roller 12 is dependent upon a proper combination of:

1. Reciprocation rate.
2. Hesitation ($\triangle t_1$, $\triangle t_2$).
3. Traverse length ($L_3 + \triangle L_1 + \triangle L_2$) and position.
4. Conveyor speed.
5. Solution delivery rate.
6. Voltage
7. Solution concentration.
8. Solvent type.
9. Disc speed.

The process described has the ability to set and control each of these parameters and consequently allow fabrication of elastomeric-coated rollers and other type parts efficiently and at uniform thicknesses up to 0.030 inch and at high-volume productivity levels. This is believed to be an accomplishment unique to the field of elastomeric coating.

While each of the examples related above is illustrative of use of a specific kind of elastomer, namely a fluoroelastomer and a polysiloxane elastomer, it will be understood that the invention is applicable to other elastomer types, including:

a) Polyurethane Elastomers.
b) Polychloroprene Elastomers.
c) Polybutadiene Elastomers.
d) Ethylene Propylene Diene Copolymers and Terpolymers.
e) Acrylonitrile-butadiene Elastomers.
f) Styrene-butadiene Elastomers.
g) Polyisoprene Elastomers.
h) Chlorinated Polyethylene Elastomers.
i) Chlorosulfonated Polyethylene Elastomers.
j) Isoprene-Isobutylene Elastomers.
k) Chlorinated Isoprene-Isobutylene Elastomers.
l) Brominated Isoprene-Isobutylene Elastomers.
m) Polyacrylate Elastomers.
n) Epichlorohydrin Elastomers.
o) Vinyl Acetate Elastomers.
p) Ethylene-Acrylic Elastomers.

Also, it will be understood that such factors as reciprocation rate (generally in the range between 6 and 22 cycles per minute) and traverse length or stroke (generally between 6 and 48 inches) are functions which tend to be limitations of workpiece size and of the particular machine used; the same may be said for the hesitation intervals (generally between 0.3 and 3.0 seconds). Specific values for these factors are thus not to be considered as limiting the scope of the invention.

The speed of rotation of disc 13 will generally be in the range between 500 and 4000 rpm, the particular speed applicable for a given case being a function of droplet-particle size, and a sufficient restraint on drying droplets in flight. To be specific, for the case of Example I above, 1950 rpm was found to be a top speed of disc rotation, to avoid a drying of solution on the disc. Of course, droplet size and the dry-out problem are also a function of the particular solvent used, as well as the concentration of elastomeric material in solution (generally in the range between 5 and 75%), suitable solvents being taken from the group which includes:

a) Acetone
b) Methyl Ethyl Ketone
c) Methyl Isobutyl Ketone
d) Tetrahydrofuran.
e) Chlorothene
f) Perchloroethylene
g) Ethyl Acetate
h) Toluene
i) Xylene
j) Hexane
k) Kerosene
l) Cyclohexane
m) Combinations of the above.

Generally, the voltage of electrotatic charging will be in the range between 10 and 120 kV, and the specific voltage selected for a given coating job will be a function of the conductivity of the solvent mixture. For the examples given above, the voltage gradient in the charged region (disc 13 to rollers 12) is in the range 4500 to 4800 volts per inch, in that it is our observation that the negatively charged droplets in the spray are attracted into roller-surface contact over a substantial arcuate extent, approaching $\pm 45^{\circ}$ with respect to the instantaneous plane which includes the disc axis and the axis of any given suspended roller 12.

Since sprayed ingredients may include toxic components, it is preferred that the zone A of electrostatic deposition be at all times under negative pressure with respect to surrounding ambient conditions. To this end, an exhaust is continuously operative as a downdraft, suggested by arrows 55 in Fig. 3 and involving air drawn into zone A from above the upper rim of the booth wall 15.

A plenum chamber (not shown) is located below the coating region to collect the exhaust flow, which often includes volatile components which are heavier than air. From the plenum chamber, an exhaust fan associated with a vertical stack 56 assures safe venting, and it will be understood that the system includes such filters, scrubbers and other devices as may be necessary to assure stack discharge of an environmentally safe exhaust.

While the invention has been described for a preferred form and for certain specific employments of the method, it will be understood that modifications may be made without departing from the scope of the invention.

CLAIMS

1. The method of using a continuously rotating disc to progressively apply an elastomeric coating to a plurality of like cylinder rolls, which method comprises orienting the disc for rotation about a vertical axis, orienting the cylindrical rolls on vertical axes in laterally spaced array along an endless path of movement which includes a segment that is cylindrically arcuate about the axis of disc rotation, said segment being of such radius as to provide substantial radial clearance between said disc and cylindrical rolls moving along the cylindrical segment of said path, vertically oscillating said disc at a repetition rate much slower than the rotary speed of said disc, the axial extent of disc oscillation being substantially in registration with the axial length of the rolls, rotating said rolls about their individual axes in the course of traversing said cylindrical segment, establishing a polarizing electrostatic field between said disc and the cylindrical rolls in the cylindrical segment of said path, continuously feeding a solvent mixture of one or more elastomeric ingredient materials to the upper surface of said disc, whereby the electrostatically polarized rotating cylindrical rolls in said segment are exposed to a mist of oppositely polarized droplets released by said disc, and directing said path through a zone of partial curing of said materials after leaving and prior to recycled entry into said cylindrical segment.

2. The method of claim 1, in which the extent of vertical reciprocation of said disc overlaps both axial ends of the suspended rolls.

3. The method of claim 1, in which each reciprocating

traverse of said disc is at substantially uniform speed.

4. The method of claim 3, in which a dwell is provided between each limit of reciprocation traverse.

5. The method of claim 1, in which said solvent mixture comprises a fluoroelastomer compound in solution with a greater proportion by weight of methylethyl ketone and methyl isobutyl ketone.

6. The method of claim 1, in which said solvent mixture comprises a liquid polysiloxane compound in a solution of toluene and methyl ethyl ketone.

7. Apparatus for applying uniformly thin elastomeric coatings to a production line of metal cylindrical rolls, comprising an endless conveyor with means for continuously moving suspended rolls to be coated at spacings along said conveyor, the path of movement of suspended rolls being endless and including a segment that is cylindrically arcuate about a vertical axis, a spray disc mounted for rotation about and for reciprocation along said axis to an extent such that the upper and lower limits of disc reciprocation extend at least to the longitudinal ends of the rolls, means for continuously rotating suspended rolls at least during their conveyed traverse of said segment, means establishing a polarizing electrostatic field between said disc and the suspended rolls at least during their conveyed traverse of said segment, means for continuously feeding a solvent mixture of one or more elastomeric-ingredient materials to the upper surface of said disc, said endless path of conveyed movement including a zone of partial curing of said materials external to said segment, for continuous

recycling of incremental coatings after partial cure of prior coatings.

8. Apparatus according to claim 7, wherein the extent of vertical reciprocation of said disc overlaps both axial ends of the suspended rolls.

9. Apparatus according to claim 7, wherein the means for continuously rotating suspended rolls comprises a fixed arcuate rub bar adjacent the path of conveyance through said segment, and a friction roller associated with each roll suspension, said friction roller having partial interference with said rub bar and having rotary driving relation with the associated roll suspension.

10. Apparatus according to claim 7, and including down-draft exhaust means operative throughout the spray-zone segment in a direction generally parallel to the axis of disc rotation and reciprocation.

11. Apparatus according to claim 7, in which control means associated with rotary-drive and reciprocation-drive of said disc establishes a range of selection of much slower reciprocation cycle than of rotary cycle.

12. Apparatus according to claim 7, in which each reciprocating traverse of said disc is at substantially uniform speed.

13. Apparatus according to claim 7, in which the reciprocation-drive means includes provision of a dwell at each limit of traverse.

14. Apparatus according to claim 7, and including selectively operable means for adjustably setting the respective dwells at said limits of traverse.

Fig.1.

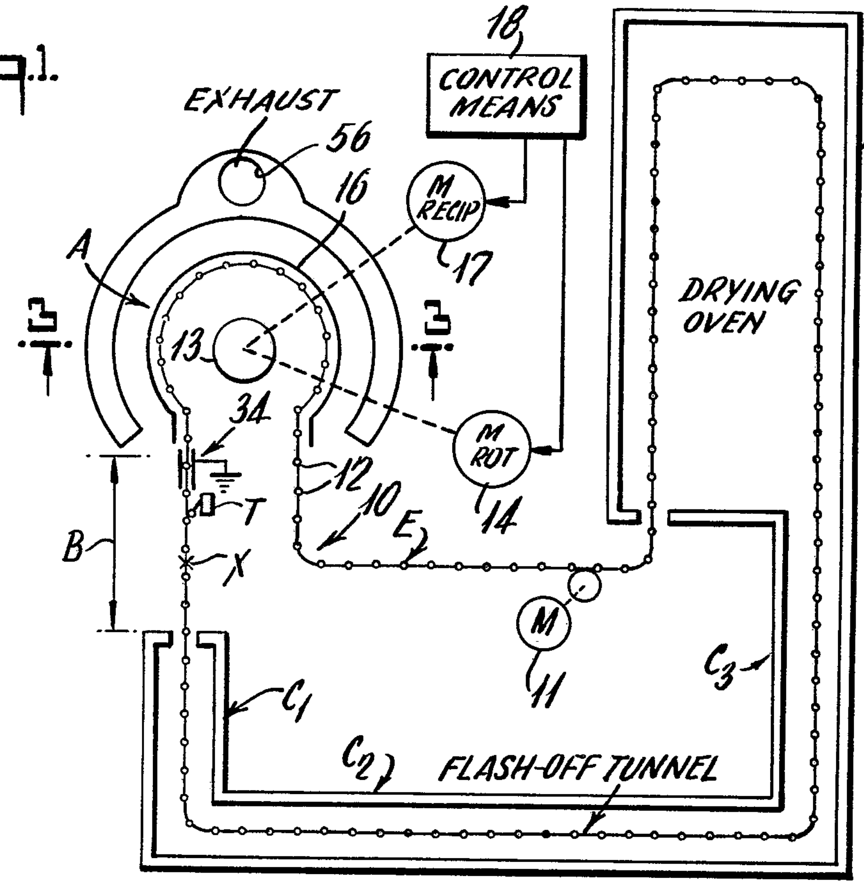

CONTROL MEANS
18
EXHAUST
56
16
M RECIP
17
A
3
3
13
34
M ROT
14
12
10
E
T
B
X
M
11
DRYING OVEN
D
C1
C2
C3
FLASH-OFF TUNNEL

Fig.3.

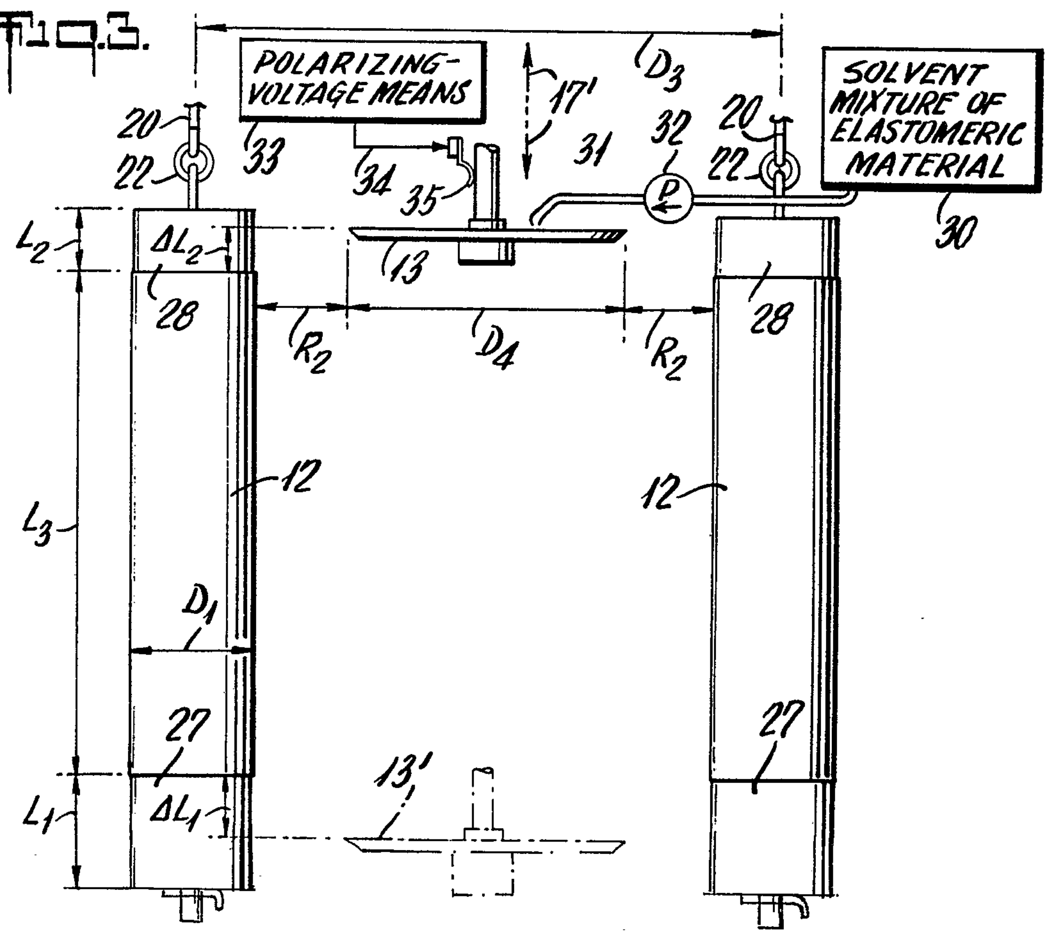

POLARIZING-VOLTAGE MEANS
SOLVENT MIXTURE OF ELASTOMERIC MATERIAL
D3
17'
20
22
33
34
35
31
32
P
30
L2
ΔL2
13
28
R2
D4
12
L3
D1
27
L1
ΔL1
13'

Fig.2.

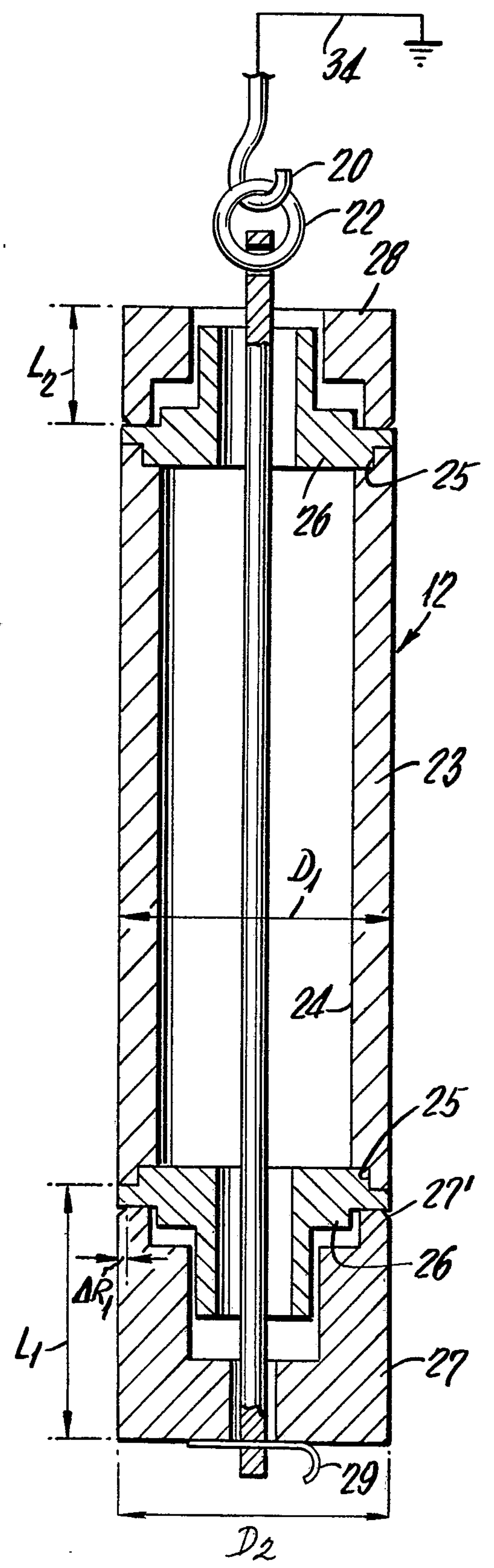
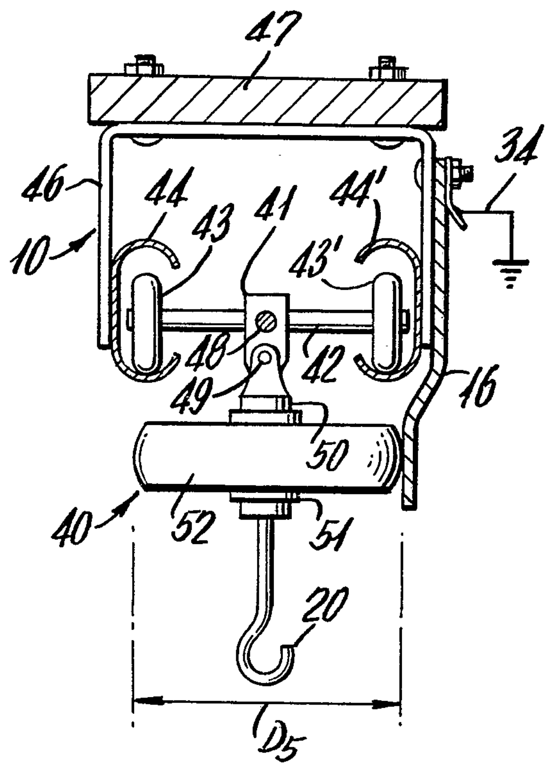


Fig.4.



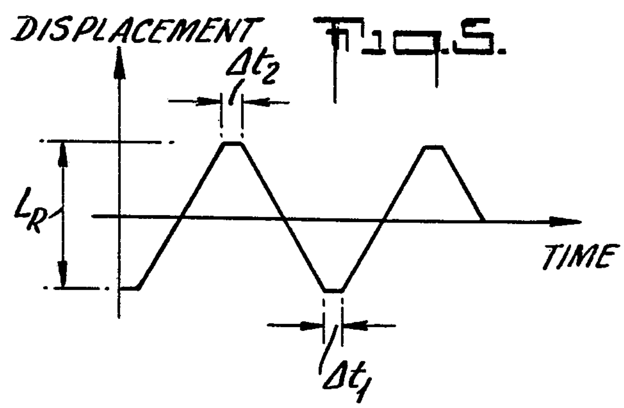


Fig.5.

European Patent Office

EUROPEAN SEARCH REPORT

0046175

Application number
EP 81 10 4941

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 128 201 (W.D. GAUTHIER) * The whole patent * --	1-3, 7-9, 11,12
	US - A - 2 884 341 (J.W. JUVINALL) * The whole patent * --	1,3,7, 9,11, 12
	US - A - 2 780 565 (R.C. JUVINALL) * Figures 2-4; column 4, lines 71-75; column 5, lines 1-31 * ----	1,7

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 05 B 5/08
B 05 D 1/04

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

B 05 B
B 05 D

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	04-11-1981	COLPAERT

EPO Form 1503.1 06.78