EUROPEAN PATENT SPECIFICATION

(54) Apparatus for removing coating from coated product
Vorrichtung zum Entschichten eines beschichteten Produktes
Dispositif pour enlever un revêtement d’un produit récouvert

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US-A- 3 951 727

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The present invention relates to an apparatus for removing a coating from a resin product according to the first part of claim 1.

In a known apparatus of that kind (US-A-3 951 727) the pressing means comprises coil springs exerting pressure forces which vary with the thickness of the products to be processed.

In recent years, due to rising interest in environmental problems and reuse of resources, the recycling of synthetic resin products has been advocated. For instance, in the automobile industry, attention is being given to the recycling of unusable products produced in the manufacturing process of resin products such as bumpers and side moldings, or the recycling of resin products removed and recovered from scrapped vehicles.

These kinds of resin products such as bumpers and side moldings are often coated in order to improve their external appearance and quality. For instance, in the case of a typical bumper, a film is coated on a resin material consisting of a thermoplastic resin such as a polypropylene resin, via a primer layer of a thermoplastic resin such as a chlorinated polyolefine resin. This coating is a thermostetting resin such as an amino-polyester resin, an amino acrylic resin, a polyester urethane resin or an acrylic urethane resin. Although these resins are liquid prior to curing, a cross-linking structure is formed therein by a baking finish process. Since this structure is strong and hard, the coated resin bumper has superior chemical resistance, heat resistance, abrasion resistance, weather resistance and surface glossiness.

However, when this coated bumper is directly crushed for reuse, the polypropylene resin material serving as the base material of the resin product becomes contaminated with coating pieces. When such a polypropylene resin material contaminated with the coating pieces is molded, the fluidity of the molten resin is inhibited by the presence of the coating pieces, with the result that molding defects such as "burning", "weld marks" and "air bubbles" may occur in the resin product. Moreover, when the parts of the same resin body have different thicknesses in order to raise the efficiency of removing a coating from the resin product, it is therefore necessary to remove the coating when recycling the coated resin product.

The problem of the invention is to provide an apparatus which is capable of automatically applying a uniform pressing force on coated resin products having different thicknesses in order to raise the efficiency of removing the coating and improving productivity.

This problem is accomplished by claim 1.
[0015] Since the pressing means applies a predetermined constant pressure force to the rolls, forcing them closer together, a uniform pressing force can be applied to the entire surface and a uniform shear stress can be applied between the resin material and the coating, even when coated resin bodies from which coatings are to be removed have different thicknesses or when an individual coated resin body has parts with different thicknesses, thereby making it possible to raise coating removal efficiency and improve productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the drawings:

Fig. 1A to Fig. 1F are explanatory views sequential-ly showing the steps of a method for recycling coated resin products used in the coating removing apparatus of the present invention;

Fig. 2 is a perspective view of the principal parts of one embodiment of the coating removing apparatus of the present invention;

Fig. 3 is an comprehensive front view of the coating removing apparatus;

Fig. 4 is a sectional view taken on line IV - IV of Fig. 3;

Figs. 5A and 5B are views explaining the operation of the coating removing apparatus, Fig. 5A showing a state when the pressing plate is positioned at a rear end position, and Fig. 5B showing a state when the pressing plate is positioned at a front end position;

Fig. 6 is a block diagram for explaining a control unit used in the coating removing apparatus;

Fig. 7 is a view of an air supply circuit used in the coating removing apparatus;

Fig. 8 is a control circuit chart explaining the operation of the coating removing apparatus;

Fig. 9 is an explanatory view showing the action of the coating removing apparatus;

Fig. 10 is a circuit diagram of an air supply circuit used in the coating removing apparatus;

Fig. 11 is a control circuit diagram explaining the action of the coating removing apparatus;

Fig. 12 is a view of a hydraulic supply circuit used in the coating removing apparatus;

Fig. 13 is a control circuit chart explaining the action of the coating removing apparatus;

Fig. 14 is a schematic view explaining another embodiment of the coating removing apparatus of the present invention;

Fig. 15 is a schematic view explaining a further embodiment of the coating removing apparatus of the present invention; and

Fig. 16 is a schematic view explaining a conventional coating removing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Referring now to the drawings, the preferred embodiments of a coating removing apparatus according to the present invention will be described, taking as an example the collection and recycling of a coated resin bumper, which is a relatively large automobile component.

[0018] Figs. 1A - 1F are explanatory views illustrating steps of a method of recycling a synthetic resin product used in the present embodiment of the coating removing apparatus.

[0019] This recycling method will next be explained.

In a synthetic resin product recovery step shown in Fig. 1C, the coating Wc of the resin member Wa is peeled and removed from the resin material Wb by means of a coating removing apparatus to be described below.

[0020] Next, in a coating removing step shown in Fig. 1C, the coating Wc of the resin member Wa is peeled and removed from the resin material Wb by means of a coating removing apparatus to be described below.

[0021] The resin material Wb obtained by removing and removing the coating Wc in the coating removing step in Fig. 1C is crushed by means of a shredder or the like to obtain crushed materials Wd in a subsequent crushing step shown in Fig. 1D.

[0022] Then, in a pelletizing step shown in Fig. 1E, the crushed materials Wd are supplied to, for instance, an extruder. In the extruder, the crushed materials Wd fed to a hopper are moved forward within a heating cylinder by the rotation of a screw, and are heated therein by means of a heater or the like. While the crushed materials Wd are moved forward in the heating cylinder, they are melted and extruded from a die to produce pellets We having a fixed shape.

[0023] Then, in a molding step shown in Fig. 1F, a resin product such as a bumper W is remolded, after adding pellets of a virgin polypropylene resin to the pellets We obtained in the pelletizing step of Fig. 1E.

[0024] Although, in the above explanation, the crushed materials Wd were processed so as to form pellets in the pelletizing step of Fig. 1E, this pelletizing step can be omitted if the crushed materials Wd are finely crushed.

[0025] Next, the coating removing apparatus which peels and removes the coating Wc from the resin material Wb in the coating removing step of Fig. 1C will be explained with reference to Fig. 2 - Fig. 9.

[0026] As the front view of Fig. 3 shows, the coating removing apparatus 1 comprises a removing unit 10 and an operation portion 30. Fig. 2 is a perspective view of the principal parts of the removing unit 10. Fig. 4 is a
As Fig. 4 shows, the removing unit 10 has a resin-side roll 11 and a coating-side roll 12 which face each other from above and below. The resin-side roll 11 and the coating-side roll 12 are made of metal and their surfaces are processed by a mirror surface finish or chrome plating. The roll 11 is rotatably supported between a pair of roll supporting members 11a which are provided on a supporting frame 13. The roll 11 is rotated by drive unit 14 (Figs. 2 and 3) such as a motor with a reduction gear.

The coating-side roll 12 is rotatably supported between a pair of coating-side roll supporting members 12a which are supported on the supporting frame 13 by means of pressing means 41 described below so as to be capable of moving upwards and downwards. The roll 12 is rotated by a drive unit 15, such as a motor with a reduction gear, which is connected to the roll 12 via a universal coupling 15a (Figs. 2 and 3).

The rolls 11 and 12 are rotated at different peripheral speeds. The peripheral speed of the coating-side roll 12 to be in contact with the surface of the coating Wc is higher than the peripheral speed of the resin-side roll 11 to be in contact with the surface of the resin material Wb. Further, the rolls 11 and 12 are rotated in opposite directions so that the resin member Wa is gripped therebetween and a pressing force is applied to the resin member Wa fed between the rolls 11 and 12.

As Fig. 4 shows, the removing unit 10 further comprises a work supply unit 20 constituting a safety unit 19 together with the operation portion 30 explained below, and a delivery unit 25 for conveying the resin material Wb from which the coating Wc has been peeled.

The work supply unit 20 has a flat plate section 21 and a pressing plate section 23. The front edge 21a of the flat plate section 21 is positioned next to the resin-side roll 11, substantially horizontally and at a height substantially corresponding to the gap between the resin-side roll 11 and the coating-side roll 12 which face one another. Furthermore, the pressing plate section 23 is driven by a pressing plate drive unit 22, for example, a pneumatic cylinder, which is provided at the rear edge 21b of the flat plate section 21. With extending and contracting operation of the pneumatic cylinder 22, the pressing plate section 23 moves along the upper surface of the flat plate section 21 backwards and forwards between a front end position 23a near the resin-side roll 11 and a rear end position 23b receding from the resin-side roll 11.

A charging section 24 is located above the pneumatic cylinder 22 provided at the rear edge 21b of the flat plate section 21. The charging section 24 comprises a slope 24a which descends as it approaches the vicinity of the resin-side roll 11, and a flange 24b which rises up along the side edges and the back edge of the slope and is U-shaped when viewed from above.

The resin member Wa inserted above the slope 24a of the charging section 24 slides down the slope 24a onto the flat plate section 21. Then, the extension of the pneumatic cylinder 22 moves the pressing plate section 23 forward from the rear end position 23b as shown in Fig. 5A to the front end position 23a shown in Fig. 5B, thereby pressing the resin member Wa into a gap between the resin-side roll 11 and the coating-side roll 12.

In addition, a delivery unit 25 is provided on the opposite side of the resin-side roll 11 and the coating-side roll 12 from the work supply unit 20. The delivery unit 25 has a bottom portion 26, having a plurality of guiding rods 26a (Fig. 3) whose upper ends are positioned in the vicinity of the surface of the resin-side roll 11 and which slope downwards as they recedes away from the resin-side roll 11 to extend outside the removing unit 10. The delivery unit 25 also has guide members 27 arranged on both sides of the bottom portion 26. The resin material Wb slides over the bottom portion 26 and is delivered therefrom.

The operation portion 30 which is provided in the vicinity of the charging section 24 of the removing unit 10 has a supporting frame 31 and a control box 32 supported by the supporting frame 31. First and second actuating switches 33 and 34 are provided separate from each other on the upper surface of the control box 32, and a first emergency stop switch 35 is provided between the actuating switches 33 and 34. In addition, a second emergency stop switch 36, provided at the bottom of the supporting frame 31, is operated by the operator by means of, for instance, a pedal.

Furthermore, as Fig. 3 shows, a control unit 37 is provided in the control box 32 of the operation portion 30 or to the removing unit 10. The control unit 37 controls the drive units 14 and 15 and the pneumatic cylinder 22 responsive to operation of the first and second actuating switches 33 and 34 and the first and second emergency stop switches 35 and 36.

Next, the operation of the switches 33, 34, 35, and 36, and the drive units 14 and 15, and the pneumatic cylinder 22 will be explained based on the block diagram shown in Fig. 6.

The control unit 37 comprises a drive signal generating section 38 and a stop signal generating section 39. Responsive to a pressing operation of the first actuating switch 33 and the second actuating switch 34 in the control box 32 by the operator, signals from the first and second switches 33 and 34 are input to the drive signal generating section 38. While the pressing operation is continuing, drive units 14 and 15 are operated based on an operational signal from the drive signal generating section 38. In addition, the pneumatic cylinder 22 extends, thereby moving pressing plate 23 from the rear end position 23b to the front end position 23a.

Then, when the operator stops the pressing operation of either one or both of the first and second actuating switches 33 and 34, in other words, when either of the actuating switches 33 and 34 is switched OFF, the drive signal generating section 38 sends a stop
signal to the stop signal generating section 39. The drive units 14 and 15 and the pneumatic cylinder 22 then stop their operations responsive to a stop signal from the stop signal generating section 39, and the pneumatic cylinder 22 contracts and returns the pressing plate 23 to the rear end position 23b.

[0040] Furthermore, during the operation of the first and second actuating switches 33 and 34, when the second emergency stop switch 36 is turned on in accordance with the pressing action or pedal action of the first emergency stop switch 35, the second emergency stop switch 36 sends a signal to the stop signal generating section 39. When the stop signal generating section 39 outputs a stop signal, the drive units 14 and 15 stop operating responsive thereto, thereby contracting the pneumatic cylinder 22 and returning the pressing plate 23 to the rear end position 23b. In addition, a warning lamp 40 or the like draws attention to this fact.

[0041] The stop signal from the stop signal generating section 39 is given priority over the operation signal from the drive signal generating section 38. In the case when the first and second actuating switches 33 and 34 are both on, the first or the second emergency stop switch 35 or 36 are used to stop the operation of the drive units 14 and 15, ensuring that the pressing plate 23 returns to the rear end position 23b in accordance with the contraction of the pneumatic cylinder 22.

[0042] The pressing means 41 supports the coating-side roll 12 so that the roll 12 is able to move upwards and downwards. The pressing means 41 have a driving portion 42, comprising a pair of pneumatic cylinders 43 which have piston rod members 43a extending downwards, which are provided to supporting frames 13a above the supporting frame 13. The pressing means 41 further have a pair of sleeves 45 provided to the supporting frame 13a on either side of each of the pneumatic cylinders 43, guiding members 46, which are inserted into the sleeves 45 and are guided upwards and downwards, and supporting members 47 which lie along the bottoms of the guiding members 46. The coating-side roll supporting members 12a are provided to the supporting members 47, and the ends of the piston rod members 43a are connected to the supporting members 47.

[0043] Then, the coating-side roll 12 is pressingly forced towards the resin-side roll 11 with a predetermined pressure using the piston rod members 43a and the coating-side roll supporting members 12a and so on, which are driven by air pressure supplied to the pneumatic cylinders 43 of the driving portion 42 from an air supply source 51 via the air supply circuit 50 shown in Fig. 7.

[0044] As shown in Fig. 7, the air supply circuit 50 has a main line 52, which connects the air supply source 51 to the pneumatic cylinders 43 via a main valve 53, a pressure adjustment valve 54 and a pressure switch 56. In addition, the air supply circuit 50 has a pilot line 57 which branches from the main line 52 between the main valve 53 and the pressure adjustment valve 54 in order to supply a pilot pressure to the pressure adjustment valve 54 via a regulator 58.

[0045] When the main valve 53 is opened, the pressure of the air fed to the pilot line 57 from the air supply source 51 is adjusted by the regulator 58 to a required air pressure, namely an air pressure which must be supplied to the pneumatic cylinders 43 in order to apply a shear stress between the resin material Wb and the coating Wc of the resin member Wa. After pressure adjustment by the regulator 58, the air is supplied to the pressure adjustment valve 54 as the pilot pressure.

[0046] Air fed from the air supply source 51 to the pressure adjustment valve 54 via the main line 52 is adjusted in accordance with the pilot pressure adjusted by the regulator 58, and is supplied to the pneumatic cylinders 43. In addition, in the case when the air pressure in the pneumatic cylinders 43 exceeds the pilot pressure, the air pressure in the pneumatic cylinders 43 is maintained at a fixed pressure corresponding to the pilot pressure by discharging excess air from a silencer 54a provided to the pressure adjustment valve 54.

[0047] Furthermore, when the pressure supplied by the pressure adjustment valve 54 to the pneumatic cylinders 43 is equal to the required air pressure, in other words, when the pressure in the pneumatic cylinders 43 has reached the required air pressure, the pressure switch 56 provided to the main line 52 between the pressure adjustment valve 54 and the pneumatic cylinders 43 switches ON. As Fig. 6 shows, when the pressure switch 56 inputs a signal to the drive signal generating section 38 of the control unit 37, the first actuating switch 33 and the second actuating switch 34 can actuate the drive units 14 and 15.

[0048] Therefore, with the air pressures of the pneumatic cylinders 43 maintained at a fixed pressure, adjusted by the pressure adjustment valve 54 in compliance with a pilot pressure set by the regulator 58, the pneumatic cylinders 43 apply a pressing force to the coating-side roll 12, pressing the roll onto the resin-side roll 11. As a result, the resin member Wa which is fed between the rolls 11 and 12 is rolled with a fixed pressing force, so that even in the cases when the resin bodies have different thicknesses or an individual resin body has parts with different thicknesses, it is possible to apply a suitable shear stress over the complete range of the portion between the resin material Wb and the coating Wc.

[0049] The operation of the coating removing apparatus 1 having the configuration described above will be described with reference to the control circuit chart in Fig. 8.

[0050] First, the operator opens the main valve 53 provided to the air supply circuit 50. When the main valve 53 is opened, pilot pressure adjusted by the regulator 58 is fed to the pressure adjustment valve 54, and air pressure adjusted by the pressure adjustment valve 54 is supplied via the main line 52 to the pneumatic cyl-
Then, when the air pressure supplied inside the pneumatic cylinders 43 reaches a required air pressure, the pressure switch 56 switches ON and sends a signal to the drive signal generating section 38 in the control unit 37 shown in Fig. 6, thereby enabling the first actuating switch 33 and the second actuating switch 34 to actuate the drive units 14 and 15, and maintaining fixed air pressure in the pneumatic cylinders 43 in a standby state.

Then, the operator inserts the resin member Wa on the slope 24a of the charging section 24 of the removing unit 10, with the coating Wc facing upwards.

The inserted resin member Wa slides down the slope 24a and is fed on the flat plate section 21 as shown in Fig. 5A, from where it is fed between the rolls 11 and 12. At this time, the pressing plate section 23 is retracted to the rear end position 23b in the vicinity of the rear edge of the flat plate section 21. Therefore, the operator is able to visually confirm the state of the resin member Wa fed onto the flat plate section 21 by viewing the apparatus from behind the slope 24a.

After the resin member Wa has been fed onto the flat plate section 21, the operator presses the first actuating switch 33 and the second actuating switch 34 which are provided on the control box 32 separate from each other. Since this pressing operation is performed on the separated first and second actuating switches 33 and 34, the operation must be performed with both hands. The operator presses the actuating switches 33 and 34 from a position considerably removed from the slope 24a. As the pneumatic cylinder 22 extends, the resin-side roll 11 and the coating-side roll 12 start to rotate in opposite directions, the coating-side roll 12 rotating at a higher peripheral speed than the resin-side roll 11, and the pneumatic cylinder 22 starts to extend.

As the pneumatic cylinder 22 extends, the pressing plate 23 moves forward from the rear end position 23b and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the resin-side roll 11 and the coating-side roll 12.

The pressing plate 23 pushes the resin member Wa forward, ensuring that the resin member Wa is forced between the resin-side roll 11 and the coating-side roll 12.

Here, the pressure adjustment valve 54 adjusts the air pressure in the pair of pneumatic cylinders 43, which form the pressing means 41, so that the pneumatic cylinders 43 are maintained at a required air pressure in compliance with a pilot pressure adjusted by the regulator 58. As a result, a predetermined pressing force is applied to the coating-side roll 12 by means of the supporting members 47 and the coating-side roll supporting members 12a and so on which are moved up and down by the piston rod member 43a, forcing the coating-side roll 12 towards the resin-side roll 11. Therefore, the resin-side roll 11 and the coating-side roll 12 roll the resin member Wa with a predetermined pressing force. Simultaneous to this, a shear stress is applied by the difference in the peripheral rotating speeds of the rolls 11 and 12 to the interface between the resin material Wb and the coating Wc, whereby the coating Wc is removed from the resin material Wb.

In this rolling process, a normally fixed pressing force is applied to the coating-side roll 12 towards the resin-side roll 11 by means of the pair of pneumatic cylinders 43 in which air pressure is maintained at a fixed pressure. As a consequence, it is possible to apply a predetermined pressing force to the resin members Wa from which coatings are to be removed, even when the resin member Wa have different thicknesses. Therefore, irrespective of the thickness of the resin members Wa, a uniform shear stress can be applied to the interface between the resin material Wb and the coating Wc, enabling the coating Wc to be removed from the resin material Wb under a uniform shear stress.

When the operator releases his hand from either one or both of the first and second actuating switches 33 and 34 at the end of the processing, the direction of the air supplied to the pneumatic cylinder 22 changes. As a result, the pressing plate 23 stops in the front end position 23a and the pneumatic cylinder 22 contracts, thereby moving the pressing plate 23 rearwards to the rear end position 23b.

The rolls 11 and 12 deliver the resin material Wb, from which the coating Wc has been removed, onto the sloping bottom portion 26 of the delivery unit 25. The resin material Wb slides down the top of the bottom portion 26, to be conveyed out of the coating removing apparatus 1 and collected.

After the coating Wc has been removed from the resin material Wb by the motion of the resin-side roll 11 and the coating-side roll 12, when the operator stops pressing the first actuating switch 33 and the second actuating switch 34 by releasing his hands from the switches 33 and 34, the drive units 14 and 15 stop, whereby the rolls 11 and 12 stop rotating.

By repeating the above operation, the coatings Wc are peeled and removed from the resin materials Wb of the resin members Wa in sequence.

During the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the air pressure in the pneumatic cylinders 43 drops below the required air pressure, the pressure switch 56 switches OFF. As shown by dotted chain line a in Fig. 8, when the pressure switch 56 is OFF, the drive signal generating section 38 sends a stop signal to the stop signal generating section 39. As shown by the dotted chain line b in Fig. 8, the drive units 14 and 15 cease operating responsive to the stop signal from the stop signal generating section 39.
whereby the resin-side roll 11 and the coating-side roll 12 stop rotating. In addition, the pneumatic cylinder 22 contracts, moving back the pressing plate 23 to stop at the rear end position 23b.

[0065] Therefore, in the case where the air pressure in the pneumatic cylinders 43 drops below the required air pressure during the coating removing operation, reducing the pressing force applied to the resin member Wa by the resin-side roll 11 and the coating-side roll 12, namely the shear stress, the coating removing operation is discontinued in order to reliably prevent the coatings from being peeled under an uneven shear stress, thereby preserving a sufficient coating removal rate.

[0066] Furthermore, during the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the operator releases his hand from either one or both of the actuating switches 33 and 34, in other words when at least either one of the first and second actuating switches 33 and 34 turns OFF, for instance, in the case shown by dashed line c in Fig. 8 in which the second actuating switch 34 turns OFF, the drive signal generating section 38 inputs a stop signal to the stop signal generating section 39. Then, as shown by dashed line d in Fig. 8, the drive units 14 and 15 stop operating responsive to a stop signal from the stop signal generating section 39, whereby the resin-side roll 11 and the coating-side roll 12 stop rotating. In addition, the pneumatic cylinder 22 contracts, moving back the pressing plate 23 to stop at the rear end position 23b.

[0067] Consequently, the resin-side roll 11 and the coating-side roll 12 are rotated only while the operator is pressing both the first actuating switch 33 and the second actuating switch 34. Since the operator necessarily operates the apparatus from a sufficient distance during this period, there is no danger of the operator’s hand or the like becoming caught between the rolls 11 and 12. Moreover, work safety is ensured by the fact that in a case when, for some reason or other, the first or second emergency stop switches 35 and 36 are actuated during the coating removing operation, the drive units 14 and 15 stop operating responsive to a stop signal from the stop signal generating section 39, the rolls 11 and 12 stop rotating, and the pneumatic cylinder 22 contracts, thereby moving back the pressing plate 23 to stop at the rear end position 23b.

[0068] Furthermore, when the resin member Wa has portions of different thicknesses as shown, for instance, in Fig. 9, the coating-side roll 12 is moved upwards and downwards by the guiding members 44 so as to adhere to the changes in the thickness of the resin member Wa. In addition, since the pneumatic cylinders 43 apply a normally constant pressing force to the coating-side roll 12 towards the resin-side roll 11, it is possible to apply a normally uniform shear stress between the resin material Wb and the coating Wc, thereby removing the coating Wc from the resin material Wb.

[0069] In the above explanation, the pressing means 41 support the coating-side roll 12 so as to be able to move upwards and downwards and apply a pressing force to the resin-side roll 11. However, a configuration is also possible wherein the resin-side roll 11 is supported so as to be able to move upwards and downwards and apply a pressing force to the coating-side roll 12.

[0070] Another embodiment of an air supply circuit used in the pressing means 41 will be described with reference to Fig. 10.

[0071] This air supply circuit 60 comprises a main line 52, which connects the air supply source 51 to the pneumatic cylinders 43 via a main valve 53, a pressure adjustment valve 54 and a pressure switch 56. The air supply circuit 50 further comprises first pilot lines 61 and 63 having a first regulator 62 and a second regulator 64 for respectively obtaining a first air pressure and a second air pressure which are different, namely different first and second pilot pressures, the first pilot lines 61 and 63 branching from the main line 52 between the main valve 53 and the pressure adjustment valve 54. Furthermore, the air supply circuit 60 comprises a switching valve 65 for selectively switching between the first pilot pressure and the second pilot pressure, which are supplied from the first and second pilot lines 61 and 63, and supplying a pilot pressure to the pressure adjustment valve 54.

[0072] When the solenoid of the switching valve 65 is ON, namely in the energized state, a pilot pressure adjusted by the second regulator 64 as the high-pressure pilot pressure is supplied to the pressure adjustment valve 54, with the result that the pneumatic cylinders 43 are set to the high pressure side and consequently apply a large shear stress between the coating Wc and the resin material Wb. Alternatively, when the solenoid of the switching valve 65 is switched OFF, as shown in Fig. 10, a pilot pressure adjusted by the first regulator 62 as the low-pressure pilot pressure is supplied to the pressure adjustment valve 54, with the result that the pneumatic cylinders 43 are set to the low pressure side and consequently apply a small shear stress between the coating Wc and the resin material Wb of the resin member Wa.

[0073] Moreover, when the pressure supplied by the pressure adjustment valve 54 to the pneumatic cylinders 43 is a required low air pressure, in other words, when the pressure in the pneumatic cylinders 43 has reached the pilot pressure adjusted by the first regulator 62, the pressure switch 56 provided to the main line 52 between the pressure adjustment valve 54 and the pneumatic cylinders 43 switches ON. As Fig. 6 shows, when the pressure switch 56 inputs a signal to the drive signal generating section 38 of the control unit 37, the first actuating switch 33 and the second actuating switch 34 actuate the drive units 14 and 15.

[0074] The operation of the coating removing apparatus 1 having the configuration described above will be explained based on the control circuit chart shown in Fig. 11.
Firstly, as Fig. 11 shows, when the main valve 53 is opened, a low-side pilot pressure adjusted by the first regulator 62 is supplied from the first pilot line 61 via the switching valve 65 to the pressure adjustment valve 54. Then, air pressure adjusted by the pressure adjustment valve 54 is supplied via the main line 52 to the pneumatic cylinders 43 of the drive unit 42.

Then, when the air pressure supplied to the pneumatic cylinders 43 reaches a predetermined air pressure, the pressure switch 56 switches on and sends a signal to the drive signal generating section 38 in the control unit 37, thereby enabling the first actuating switch 33 and the second actuating switch 34 to actuate the drive units 14 and 15, and maintaining a predetermined air pressure corresponding to the first pilot pressure in the pneumatic cylinders 43 in a standby state.

Then, in the case when the air pressure required for processing the resin member Wa to be processed is low, the resin member Wa is charged into the charged section 24, the first actuating switch 33 and the second actuating switch 34 are switched on by the pressure in the pneumatic cylinders 43 in compliance with a pilot pressure from the drive signal generating section 38. In addition, the pneumatic cylinder 22 starts to extend, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12. The peripheral speeds of the rolls 11 and 12 enable a shear stress to be applied to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

During the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the air pressure in the pneumatic cylinders 43 drops below a predetermined pressure, the pressure switch 56 switches off. As shown by dotted chain line e in Fig. 11, when the pressure switch 56 is off, the drive signal generating section 38 sends a stop signal to the stop signal generating section 39. As shown by the dotted chain line f in Fig. 11, the drive units 14 and 15 cease operating responsive to the stop signal from the stop signal generating section 39, whereby the rolls 11 and 12 stop rotating. In addition, the pneumatic cylinder 22 contracts, moving back the pressing plate 23 to stop at the rear end position 23b.

Therefore, when the air pressure required for processing the resin member Wa to be processed is high, the solenoid of the switching valve 65 is set ON, whereby a second actuating pressure which has been adjusted by the second regulator 64 is supplied to the pressure adjustment valve 54. Thus the pneumatic cylinders 43 of the pressing means 41 are maintained at an air pressure which has been adjusted by the pressure adjustment valve 54 in compliance with the second pilot pressure.

Therefore, when the resin member Wa is charged at the charging section 24 and the first actuating switch 33 and the second actuating switch 34 are set to ON by means of the pressing operation, the drive units 14 and 15 become operative in response to an actuation signal from the drive signal generating section 38. In addition, the pneumatic cylinder 22 is actuated, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12. Thus the resin member Wa is fed between the rolls 11 and 12 to be rolled with a fixed pressing force. The difference in the peripheral speeds of the rolls 11 and 12 enables a shear stress to be applied to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

During the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the air pressure in the pneumatic cylinders 43 drops below a predetermined pressure, the pressure switch 56 switches off. As shown by dotted chain line e in Fig. 11, when the pressure switch 56 is off, the drive signal generating section 38 sends a stop signal to the stop signal generating section 39. As shown by the dotted chain line f in Fig. 11, the drive units 14 and 15 cease operating responsive to the stop signal from the stop signal generating section 39, whereby the rolls 11 and 12 stop rotating. In addition, the pneumatic cylinder 22 contracts, moving back the pressing plate 23 to stop at the rear end position 23b.

Therefore, when the air pressure required for processing the resin member Wa to be processed is high, the solenoid of the switching valve 65 is set ON, whereby a second actuating pressure which has been adjusted by the second regulator 64 is supplied to the pressure adjustment valve 54. Thus the pneumatic cylinders 43 of the pressing means 41 are maintained at an air pressure which has been adjusted by the pressure adjustment valve 54 in compliance with the second pilot pressure.

Therefore, when the resin member Wa is charged at the charging section 24 and the first actuating switch 33 and the second actuating switch 34 are set to ON by means of the pressing operation, the drive units 14 and 15 become operative in response to an actuation signal from the drive signal generating section 38. In addition, the pneumatic cylinder 22 is actuated, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12. Thus the resin member Wa is fed between the rolls 11 and 12 to be rolled with a fixed pressing force. The difference in the peripheral speeds of the rolls 11 and 12 enables a shear stress to be applied to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

Therefore, when the air pressure required for processing the resin member Wa to be processed is high, the solenoid of the switching valve 65 is set ON, whereby a second actuating pressure which has been adjusted by the second regulator 64 is supplied to the pressure adjustment valve 54. Thus the pneumatic cylinders 43 of the drive unit 42 are maintained at an air pressure which has been adjusted by the pressure adjustment valve 54 in compliance with the second pilot pressure.

Therefore, when the resin member Wa is charged at the charging section 24 and the first actuating switch 33 and the second actuating switch 34 are set to ON by means of the pressing operation, the drive units 14 and 15 become operative in response to an actuation signal from the drive signal generating section 38. In addition, the pneumatic cylinder 22 is actuated, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12. Thus the resin member Wa is fed between the rolls 11 and 12 to be rolled with a fixed pressing force. The difference in the peripheral speeds of the rolls 11 and 12 enables a shear stress to be applied to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

In the embodiments described above, the pressing means 41 are controlled by means of air pressure supplied to the pneumatic cylinders 43 of the driving portion 42, but the pressing means 41 can be controlled hydraulically. An embodiment of the present invention in which the pressing means 41 are hydraulically controlled will be explained.
[0085] Fig. 12 shows a hydraulic supply circuit 70 used in the pressing means 41. In the diagram, 71 is a pair of hydraulic cylinders, which are provided to the supporting frame 13 instead of the pneumatic cylinders 43. The piston rod members 71a on the tip of the hydraulic cylinders 71 are joined to the supporting members 47.

[0086] The hydraulic supply circuit 70 supplies oil from an actuating oil supply source 72, such as an oil reservoir, to the hydraulic cylinders 71.

[0087] Provided in sequence from the actuating oil supply source 72 are a hydraulic pump 74 which pumps actuating oil via a strainer 73, a relief valve 75 which controls the pressure of the oil sent by the hydraulic pump 74 to a predetermined value, a hydraulic switch control portion 76 which switches oil pressure sent from the relief valve 75, and a flow rate control valve 80 which controls the amount of oil from the hydraulic switch control portion 76 and supplies it to the hydraulic cylinders 71. Furthermore, a pressure switch 81 which detects the oil pressure in the hydraulic cylinders 71 is provided between the flow rate control valve 80 and the hydraulic cylinders 71. In addition, an electric motor 82 or the like is provided as drive means for driving the hydraulic pump 74.

[0088] The hydraulic switch control portion 76 comprises a switch valve 77, a first line 78 which supplies oil pressure from the switch valve 77 via a first pressure reduction valve 78a to the flow rate control valve 80, and a second line 79 which supplies oil pressure from the switch valve 77 via a second pressure reduction valve 79a to the flow rate control valve 80. When the switch valve 77 is OFF, as shown in Fig. 12, namely when the switch valve 77 is not energized, the oil pressure from the relief valve 75 passes through the first line 78 where it is reduced by the first pressure reduction valve 78a and supplied to the flow rate control valve 80. Alternatively, when the switch valve 77 is energized, in other words when the switch valve 77 is switched ON, oil pressure from the relief valve 75 passes through the second line 79 where it is reduced by the second pressure reduction valve 79a and supplied to the flow rate control valve 80.

[0089] Therefore, when the switch valve 77 is OFF, oil pressure from the hydraulic pump 74, which has been adjusted to a predetermined pressure value by means of the relief valve 75, is supplied to the first line 78, where it is reduced to the low pressure and supplied to the hydraulic cylinders 71, whereby the hydraulic cylinders 71 are adjusted to the low pressure and a small shear stress is resultantly applied to the resin member Wa. Moreover, when the oil pressure in the hydraulic cylinders 71 has reached the required oil pressure, in other words the oil pressure adjusted by the first pressure reduction valve 78a, the pressure switch 81 switches ON and inputs a signal to the drive signal generating section 38 of the control unit 37 shown in Fig. 6, whereby the first actuating switch 33 and the second actuating switch 34 actuate the drive units 14 and 15.

[0091] Next, the operation of the coating removing apparatus 1 having the above configuration will be explained referring to the control circuit chart shown in Fig. 13.

[0092] Firstly, as Fig. 13 shows, when the hydraulic pump 74 starts to operate, the oil pressure adjusted by the relief valve 75 is supplied via the switch valve 77 to the first pressure reduction valve 78a, and oil pressure adjusted to a low pressure by the first pressure reduction valve 78a is supplied to the hydraulic cylinders 71 of the drive unit 42.

[0093] Then, when the oil pressure supplied to the hydraulic cylinders 71 reaches a predetermined pressure, the pressure switch 81 switches ON and sends a signal to the drive signal generating section 38 of the control unit 37, thereby enabling the first actuating switch 33 and the second actuating switch 34 to actuate the drive units 14 and 15. In addition, the first pressure reduction valve 78a maintains a fixed oil pressure in the hydraulic cylinders 71 in the standby state.

[0094] In the case when the oil pressure required for processing the resin member Wa to be processed is low, the resin member Wa is inserted into the insert portion 24, the first actuating switch 33 and the second actuating switch 34 are switched ON by the pressing operation described above, and the drive units 14 and 15 become operative in response to an actuate signal from the drive signal generating section 38. In addition, the pneumatic cylinder 22 starts to extend, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12.

[0095] Here, since the oil pressures of the hydraulic cylinders 71 of the pressing means 41 are maintained at a fixed pressure adjusted by the first pressure reduction valve 78a, the resin member Wa which is fed between the rolls 11 and 12 is rolled with a predetermined pressing force applied thereto. The difference in the peripheral speeds of the resin-side roll 11 and the coating-side roll 12 enables a shear stress to be applied to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

[0096] Alternatively, in the case when the oil pressure required for processing the resin member Wa to be processed is high, the switch valve 77 is switched to ON, and by switching the switch valve 77, an oil pressure which has been adjusted by the second pressure reduction valve 79a is supplied to the hydraulic cylinders 71.
and maintained at a fixed pressure.

[0097] Therefore, when the resin member Wa is charged in the charging section 24 and the first actuating switch 33 and the second actuating switch 34 are set to ON by means of the pressing operation, the drive units 14 and 15 and the pneumatic cylinder 22 are actuated responsive to an actuate signal from the drive signal generating section 38, whereby the pressing plate 23 moves forward and pushes the resin member Wa, which has been fed onto the flat plate section 21, between the rolls 11 and 12. Thus the resin member Wa is rolled between the rolls 11 and 12. In addition, the difference in the peripheral speeds of the resin-side roll 11 and the coating-side roll 12 applies a shear stress to the portion between the resin material Wb and the coating Wc, removing and removing the coating Wc from the resin material Wb.

[0098] Here, during the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the oil pressure in the hydraulic cylinders 71 drops below a predetermined pressure, the pressure switch 81 switches OFF. As shown by dotted chain line j in Fig. 13, when the pressure switch 81 is OFF, the drive signal generating section 38 sends a stop signal to the stop signal generating section 39. As shown by dotted chain line k in Fig. 13, the actuation of the drive units 14 and 15 ceases responsive to the stop signal from the stop signal generating section 39, whereby the rolls 11 and 12 stop rotating. In addition, the pneumatic cylinder 22 contracts as shown by dotted chain line l in Fig. 13, moving back the pressing plate 23 to stop at the rear end position 23b.

[0099] Therefore, when the pressing force between the resin-side roll 11 and the coating-side roll 12 has dropped, the coating removing operation is discontinued in order to prevent a reduction in the coating removal rate.

[0100] Furthermore, during the removing of the coating operated by pressing the first actuating switch 33 and the second actuating switch 34, when the operator releases his hand from at least one of the first and second actuating switches 33 and 34, in other words when either of the actuating switches 34 and 34 turns OFF, for instance, in the case shown by dashed line n in Fig. 13 in which the second actuating switch 34 turns OFF, the drive signal generating section 38 inputs a stop signal to the stop signal generating section 39. Then, as shown by dashed line o in Fig. 13, the drive units 14 and 15 stop operating responsive to a stop signal from the stop signal generating section 39, whereby the rolls 11 and 12 stop rotating. In addition, as shown by dashed line p in Fig. 13, the pneumatic cylinder 22 contracts, thereby moving back the pressing plate 23 to stop at the rear end position 23b. Furthermore, work safety is ensured by the fact that in a case when, for some reason or other, the first or second emergency stop switches 35 or 36 are actuated during the coating removing operation, the drive units 14 and 15 stop operating responsive to a stop signal from the stop signal generating section 39, the rolls 11 and 12 stop rotating, and the pneumatic cylinder 22 contracts, thereby moving back the pressing plate 23 to stop at the backward end position 23b.

[0101] Another embodiment of the coating removing apparatus of the present invention will be described based on Fig. 14.

[0102] This coating removing apparatus comprises an upper surface coating removing unit 110, a lower surface coating removing unit 120, and a conveying unit 130 provided therebetween.

[0103] In the upper coating removing unit 110, resin members Wa charged from the charging section 24 are fed between the resin-side roll 11 and the coating-side roll 12 by the pressing plate 23. The resin-side roll 11 is supported so as to be able to rotate freely between resin-side roll supporting members 11a provided on the supporting frame 13. The coating-side roll 12 is supported by coating-side roll supporting members 12a which, as in the embodiments already described, are supported by pressing force means 41 and guide members 44, so that the resin-side roll 11 and the coating-side roll 12 rotate at different peripheral speeds. For instance, the coating-side roll 12 may rotate at a higher peripheral speed than the resin-side roll 11. In addition, the resin-side roll 11 and the coating-side roll 12 rotate in opposite directions.

[0104] Air is supplied to the pneumatic cylinders 43 by means of the air supply circuits 50 or 70 in Fig. 7 and Fig. 10 described above.

[0105] Therefore, the resin member Wa charged from the charging section 24 is rolled between the resin-side roll 11 and the coating-side roll 12, which apply a fixed pressing force. In addition, a suitable shear stress is applied between the resin material Wb and the coating Wc on the upper surface thereof, removing the coating Wc from the resin material Wb.

[0106] The resin material Wb, from the upper surface of which the coating Wc has been peeled and removed in the upper surface coating removing unit 110, is conveyed to the lower coating removing unit 120 by the conveying unit 130. This conveying unit 130 has upper rolls 131 and lower rolls 132, which are rotated by a drive unit such as a motor using transmission means such as a chain or a belt or the like. The resin material Wb is gripped between the upper and lower rolls 131 and 132 and is conveyed therethrough.

[0107] The lower coating removing unit 120 has a resin-side roll 11 and a coating-side roll 12 which apply a pressing force to the coating on the lower surface of the resin material Wb conveyed by the conveying unit 130. The coating-side roll 12 is supported so as to be able to rotate freely between coating-side roll supporting members 12a which are provided on the supporting frame 13. The resin-side roll 11 is supported by the resin-side roll supporting members 11a which are supported on the supporting frame 13 by pressing force means 41 and guide members 44. The resin-side roll 11 and the coat-
ing-side roll 12 rotate at different peripheral speeds and in opposite directions.

[0108] Then, as in the upper side coating removing unit 110, air is supplied to the pneumatic cylinders 43 from the air supply circuits 51 or 70 shown in Figs. 7 and 10.

[0109] Therefore, the resin material Wb conveyed by the conveying unit 130 to the lower surface coating removing unit 120 is rolled between the resin-side roll 11 and the coating-side roll 12, which apply a fixed pressing force thereto. In addition, a suitable shear stress is applied between the resin material Wb and the coating Wc on the lower surface thereof, removing the coating Wc from the resin material Wb. Thereafter, the resin material Wb is discharged by the delivery unit 25.

[0110] Furthermore, it is also possible to replace the pneumatic cylinders 43 provided to the upper surface and lower surface coating removing units 110 and 120 with hydraulic cylinders 71. Oil pressure may be supplied to these hydraulic cylinders 71 by means of the hydraulic supply circuit 70 shown in Fig. 12.

[0111] A further embodiment of the coating removing apparatus of the present invention will be described based on Fig. 15.

[0112] This coating removing apparatus comprises a resin-side roll 11, a coating-side roll 12, and a third roll 17 facing the resin-side roll 11.

[0113] The resin-side roll 11 is rotatably supported by resin-side roll supporting members 11a which are supported on the supporting frame 13. The coating-side roll 12 is rotatably supported by the coating-side roll supporting members 12a, which are supported on an upper supporting frame 13a by the pressing means 41 and the guiding members 44. The resin-side roll 11 and the coating-side roll 12 are rotated at different peripheral speeds, the peripheral speed of the coating-side roll 12 being higher than the peripheral speed of the resin-side roll 11. In addition, the rolls 11 and 12 rotate in opposite directions.

[0114] Air is supplied to the pneumatic cylinders 43 provided in the pressing force means 41 from the air supply circuits 51 or 70 shown in Figs. 7 and 10.

[0115] The third roll 17 is rotatably supported on third roll supporting members 17a, which are supported by the pressing force means 41 and the guiding members 44 provided on a lower frame 13b of the supporting frame 13. The third roll 17 is rotated at a lower peripheral speed than the resin-side roll 11, and in the opposite direction thereto. In addition, air is supplied to the pneumatic cylinders 43 of the pressing force means 41 which support the third roll 17 by means of the air supply circuits 51 or 70 shown in Figs. 7 and 10.

[0116] Therefore, the resin member Wa charged between the resin-side roll 11 and the coating-side roll 12 and rolled with fixed pressing force controlled by the pressing force means 41. In addition, the difference in the peripheral speeds to the two rolls 11 and 12 applies a fixed shear stress between the resin material Wb and the coating Wc, removing the coating Wc from the resin material Wb.

[0117] Here, since the peripheral rotational speed of the coating-side roll 12 is higher than the peripheral rotation speed of the resin-side roll 11, the resin member Wa is more largely drawn on the coating-side roll 12 than on the resin-side roll 11, so that the resin material Wb is discharged while being curved along the roll surface of the resin-side roll 11.

[0118] The resin material Wb, which has been discharged while being curved along the roll surface of the resin-side roll 11, reaches the portion between the resin-side roll 11 and the third roll 17 and is nipped therebetween.

[0119] The resin material Wb nipped between the resin-side roll 11 and the third roll 17 is rolled again by the pressing force means 41 against the resin-side roll 11 and the third roll 17. In addition, in accordance with the difference in the peripheral speeds of the rolls 11 and 17, the coating-side roll 12 and the resin-side roll 11 apply a shear stress between the resin material Wb and a coating or a mist formed on the reverse surface of the resin material Wb from which the coating Wc has already been removed, thereby removing and removing the coating or mist from the resin member Wa.

[0120] Therefore, the resin member Wa charged between the resin-side roll 11 and the coating-side roll 12 is continuously rolled by optimal pressing forces between the coating-side roll 12 and the resin-side roll 11, and between the resin-side roll 11 and the third roll 17. In addition, shear stress is applied so that the coating or mist formed on both surfaces of the resin member Wa is peeled and removed in a single step, thereby efficiently removing the coatings or mists from the resin member.

[0121] Furthermore, since the peripheral rotational speed of the third roll 17 is set to a speed higher than the peripheral rotation speed of the resin-side roll 11, by re-removing coating pieces which remain on the surfaces of the resin material Wb, from which the coating has been peeled by the resin-side roll 11 and the coating-side roll 12, it is possible to more reliably peel and remove the coating from the surfaces of the resin member.

[0122] Furthermore, hydraulic cylinders 71 may be provided instead of the pneumatic cylinders 43. By providing, for instance, the hydraulic supply circuit 70 shown in Fig. 12, or the like, these hydraulic cylinders 71 can be controlled by means of oil pressure.

[0123] According to the coating removing apparatus of the present invention explained above, a coated resin member is rolled between rolls rotating at different peripheral speeds and in different directions, while applying a shear stress between the resin material and the coating so as to remove the coating from the resin material. Furthermore, since pressing means force the rolls close together by means of a fixed force, a normally uniform shear stress is applied between the resin material and the coating even in the cases when the coated resin bodies have different thicknesses or an individual coat-
ed resin body has parts with different thicknesses. This has the excellent results of obtaining an extremely high coating removing rate, and highly efficient and stable productivity, thereby contributing considerably to recycling of a wide range of coated resin products.

Claims

1. An apparatus for removing a coating from a resin product, having a coating removing unit which includes:

   - first and second rolls (12, 11) disposed in parallel with a roll gap therebetween to allow a synthetic resin product (Wa) having a coating (Wc) thereon to pass through the roll gap;
   - roll drive means (15, 14) for rotating said first and second rolls (12, 11) at different peripheral speeds and in opposite directions to cause a shear stress between the synthetic resin product (Wa) and the coating (Wc) which are passed through said roll gap, thereby removing the coating from the synthetic resin product; and
   - pressing means (41) for applying a pressing force to said first roll (12) to urge the first roll toward the second roll (11); characterised in that:

     - said pressing means (41) is a fluid cylinder means (43, 71) for applying a predetermined constant fluid pressing force;
     - a pressure switch (56) is provided for detecting a required pressing force applied to said first roll;
     - an actuating switch device (33, 34) is provided for actuating said roll drive means (15, 14) to rotate said first and second rolls; and
     - a control unit (37) is provided to control said fluid cylinder means (43) and said roll drive means (15, 14) based upon a pressing force detected by said pressure switch (56) in such a manner that coated resin products (Wa) are rolled with said predetermined constant pressing force maintained independently of thicknesses of the products with a uniform shear stress applied to the entire coating and that said actuating switch device (33, 34) is capable of actuating said roll drive means (15, 14) once the pressing force attains said predetermined constant pressing force and is disabled to actuate said roll drive means (15, 14) if the pressing force is not at said constant predetermined pressing force.

2. The apparatus according to claim 1, characterised in that said fluid cylinder means is a pneumatic cylinder means (43).

3. The apparatus according to claim 1, characterised in that said fluid cylinder means is a hydraulic cylinder means (71).

4. The apparatus according to anyone of claims 1 to 3, characterised by:

   - a main line (52) connected to said fluid pressing device (43) to supply a fluid from a fluid supply source (51) to the fluid cylinder means;
   - a pressure adjustment valve (54) provided in said main line (52) to adjust the pressure of the fluid being supplied to the fluid cylinder means to a predetermined value;
   - the pressure switch (56) being interposed between said fluid cylinder means (43) and said pressure adjustment valve (54) enabling a drive signal generating section (38) to actuate the roll drive units (14, 15) when the pressure in the cylinders has attained a required pressure and disables the drive signal generating section when the pressure in the cylinders drops below the required pressure;
   - a pilot line (57) branching from said main line (52) and connecting said fluid supply source (51) to said pressure adjustment valve (54); and
   - a regulator (58) provided in said pilot line (57) to control pressure of the fluid in the pilot line (57) to a predetermined value.

5. The apparatus according to anyone of claims 1 to 4, characterised in that said actuating switch device includes a pair of manually operable actuating switches (33, 34) which generate a start signal for performing a removing operation of the coating from the resin product when both of the actuating switches are simultaneously pressed.

6. The apparatus according to claim 5, characterised in that:

   - a pair of manually operable emergency stop switches (35, 36) is provided adjacent to said actuating switches (33, 34) to output a stop signal to stop the removing operation when either one of the emergency stop switches is operated.

7. The apparatus according to any one of claims 1 to 6, characterised in that a second coating removing unit (120) identical to said coating removing unit (110) is provided, and said conveying means (130) is disposed between the roll gaps of the two coating removing unit (110, 120), to convey resin products from said coating removing unit (110) to said second coating removing unit (120).

8. The apparatus according to any one of claims 1 to 6, characterised in that it further comprises:
a third roll (17) provided adjacent to said second roll (11) to define therebetween a further roll gap through which said synthetic resin products (Wa) that has passed through said roll gap is caused to pass;
drive means for rotating the third roll (17) at a different peripheral speed from the second roll (11) and in an opposite direction to said second roll (11); and
a control unit for controlling the second fluid cylinder means (43) to cause the second pressing force to take a predetermined constant value so that coated resin products are rolled with a fixed pressing force independently of the thicknesses of the coated resin products to thereby apply a uniform shear stress to an entire surface of the coating.

9. The apparatus according to claim 1, characterised in that it further comprises:
a main line (52) connected to said pneumatic pressing device (43) to supply a fluid from a fluid supply source (51) to the fluid cylinder means;
a pressure adjustment valve (54) provided in said main line (52) to adjust the pressure of the fluid being supplied to the fluid cylinder means to a predetermined value;
the pressure switch (56) being interposed between said fluid cylinder means (43) and said pressure adjustment valve (54) enabling a drive signal generating section (38) to actuate the roll drive units (14, 15) when the pressure in the cylinders has attained a required pressure and disables the drive signal generating section when the pressure in the cylinders drops below the required pressure;
a first pilot line (61) provided in parallel with said fluid supply source (51) to said pressure adjustment valve (54); and
a switching valve (65) provided in said first pilot line (61);
a second pilot line (63) provided in parallel with said first pilot line (61) and said main line (52) and connecting said fluid supply source (51) to said switching valve (65);
a first regulator (62) provided in said first pilot line (61) for setting a fluid pressure in the main line (52) to a lower predetermined pressure value; and
a second regulator (64) provided in said second pilot line (63) for setting the fluid pressure in the main line (52) to a higher predetermined pressure.

10. The apparatus according to claim 1, characterised in that it further comprises:
a first line (78) connected to said fluid cylinder means (71) to supply a fluid from a fluid supply source (72) to the fluid cylinder means (71);
a flow rate control valve (80) provided in said first line (78) to control the pressure of the fluid to a predetermined value;
a pressure switch (81) provided in the first line (78) between said fluid cylinder means (71) and said flow rate control valve (80) enabling a drive signal generating section (38) to actuate the roll drive units (14, 15) when the pressure in the cylinders has attained a required pressure and disables the drive signal generating section when the pressure in the cylinders drops below the required pressure;
a switching valve (77) provided in said first line (78);
a first pressure reduction valve (78a) provided in said first line (78) between said switching valve (77) and said flow rate control valve (80); a second line (79) provided in parallel with said first line (78) and connecting said switching valve (77) to said flow rate control valve (80);
a second pressure reduction valve (79a) provided in said second line (79) between said switching valve (77) and said flow rate control valve (80); and
a pressure regulator (75) provided between said fluid supply source (72) and said switching valve (77) to control the fluid pressure to a predetermined pressure value.

Patentansprüche

1. Vorrichtung zum Entfernen einer Schicht von einem Harzgegenstand mit einer Schichtentfernungseinheit, die umfasst:
eine erste und eine zweite Walze (12, 11), die parallel zueinander angeordnet sind und zwischen sich einen Walzenspalt bilden, um ein Kunstharzgegenstand (Wa) mit einer Schicht (Wc) darauf durch den Walzenspalt hindurchpassieren zu lassen;
eine Walzenantriebseinrichtung (15, 14) zum Drehen der ersten und zweiten Walze (12, 11) mit unterschiedlichen Umfangsgeschwindigkeiten und in entgegengesetzten Richtungen; um eine Scherbeanspruchung zwischen dem Kunstharzgegenstand (Wa) und der Schicht (Wc) hervorzurufen, welche den Walzenspalt
durchlaufen, wodurch die Schicht von dem Kunstharzgegenstand entfernt wird; eine Druckeintrichtung (41), um der ersten Walze (12) eine Druckkraft mitzuteilen, damit die erste Walze zur zweiten Walze gedrückt wird; 

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Druckeintrichtung (41) eine Fluideinrichtung (43), zum Ausüben einer vorbestimmten, konstanten Fluiddruckkraft ist; ein Druckschalter (56) zum Erfassen einer erforderlichen Druckkraft vorgesehen ist, die der ersten Walze mitgeteilt wird; eine Schalterbetätigungseinrichtung (33, 34) zum Betätigen der Walzenantriebseinrichtung (15, 14) vorgesehen ist, um die erste und zweite Walze zu drehen; und eine Steuereinheit (37) vorgesehen ist, um die Fluidzylindereinrichtung (43) und die Walzenantriebseinrichtung (15, 14) auf der Basis einer von dem Druckschalter (56) erfaßten Druckkraft derart zu steuern, daß die beschichteten Harzgegenstände (Wa) bei einer vorbestimmten konstanten Druckkraft gezogen werden, die unabhängig von der Dicke der Gegenstände gleichbleibt, wobei eine gleichmäßige Scherbbeanspruchung der gesamten Schicht mitgeht, und daß die Schalterbetätigungseinrichtung (33, 34) die Walzenantriebseinrichtung (15, 14) dann betätigen kann, wenn die Druckkraft den vorbestimmten konstanten Druckwert erreicht, und daß die Schalterbetätigungseinrichtung die Walzenantriebseinrichtung (15, 14) dann nicht betätigen kann, wenn die Druckkraft nicht gleich der konstanten vorbestimmten Druckkraft ist. 

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Fluidzylindereinrichtung eine pneumatische Zylindereinrichtung (43) ist. 

4. Vorrichtung nach einem der Ansprüche 1 bis 3, gekennzeichnet durch eine Hauptleitung (52), die mit der Fluiddruckeintrichtung (53) verbunden ist, um ein Fluid von einer Fluidversorgungsquelle (51) der Fluidzylindereinrichtung zuzuführen; ein Druckeinstellventil (54), das in der Hauptleitung (52) vorgesehen ist, um den Druck des der Fluidzylindereinrichtung zugeführten Fluids auf einen vorbestimmten Wert einzustellen; wobei der Druckschalter (56) zwischen der Fluidzylindereinrichtung (53) und dem Druckeinstellventil (54) angeordnet ist und einen Antriebssignalzeugungsabschnitt (38) zum Betätigen der Walzenantriebseinheiten (14, 15) aktiviert, wenn der Druck in den Zylindern einen erforderlichen Wert erreicht hat, und den Antriebssignalzeugungsabschnitt deaktiviert, wenn der Druck in den Zylindern unter den erforderlichen Wert fällt; wobei eine Führungsleitung (57) von der Hauptleitung (52) abzweigt und die Fluidversorgungsquelle (51) mit dem Druckeinstellventil (54) verbindet; und wobei ein Regulator (58) in der Führungsleitung (57) vorgesehen ist, um den Fluiddruck in der Führungsleitung (57) auf einen vorbestimmten Wert zu regulieren. 

5. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Schalterbetätigungseinrichtung ein Paar manuell bedienbare Betätigungsschalter (33, 34) umfaßt, die ein Startsignal zum Entfernen der Schicht von dem Harzgegenstand erzeugen, wenn beide Betätigungsschalter gleichzeitig gedrückt werden. 


7. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß eine zweite, zur Schichtentfernungseinheit (110) identische Schichtentfernungseinheit (120) vorgesehen ist und ein Förderer (130) zwischen den Walzenspalten der beiden Schichtentfernungseinheiten (110, 120) angeordnet ist, um Harzgegenstände von der Schichtentfernungseinheit (110) zur zweiten Schichtentfernungseinheit (120) zu transportieren. 

8. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß sie außerdem umfaßt: eine dritte Walze (17), die benachbart der zweiten Walze (11) vorgesehen ist, um dazwischen einen weiteren Walzenspalt zu definieren, den die Kunstharzgegenstände (Wa), die den Walzenspalt passiert haben, durchlaufen sollen; eine Antriebeinrichtung zum Drehen der dritten Walzen (17) mit einer gegenüber der zweiten Walze unterschiedlichen Umfangsgeschwindigkeit und in einer gegenüber der zweiten Walze (11) entgegengesetzten Richtung; eine zweite Fluidzylindereinrichtung (43), um eine vorbestimmte zweite Druckkraft der dritten Walze (17) mitzuteilen, damit die dritte Walze zur zweiten Walze (11) gedrückt wird; eine Steuereinheit zum Steuern der zweiten Fluidzylindereinrichtung (43), damit die zweite
Druckkraft einen vorbestimmten konstanten Wert annimmt, so daß die beschichteten Harzgegenstände mit einer festgelegten Druckkraft unabhängig von der Dicke der beschichteten Harzgegenstände gewalzt werden, um dadurch eine gleichmäßige Scherbeanpruchung der gesamten Oberfläche der Schicht mitzuteilen.

9. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sie außerdem umfaßt:

   eine Hauptleitung (52), die mit der pneumatischen Druckeinrichtung (43) verbunden ist, um ein Fluid von einer Fluidversorgungsquelle (51) der Fluidzylindereinrichtung zuzuführen; ein Druckeinstellventil (54), das in der Hauptleitung (52) vorgesehen ist, um den Druck des Fluids, das der Fluidzylindereinrichtung zugeführt wird, auf einen vorbestimmten Druck einzustellen;

wobei der Druckschalter (56) zwischen der Fluidzylindereinrichtung (43) und dem Druckeinstellventil (54) angeordnet ist und einen Antriebssignaleregulierungsschnitt (38) aktiviert, um die Walzenantriebeinheiten (14, 15) zu betätigen, wenn der Druck in den Zylindern einen erforderlichen Wert erreicht hat, und den Antriebssignaleregulierungsschnitt deaktiviert, wenn der Druck in den Zylindern unter den erforderlichen Wert fällt; wobei eine erste Führungsleitung (61) parallel zur Hauptleitung (52) vorgesehen ist und die Fluidversorgungsquelle (51) mit dem Druckeinstellventil (54) verbunden ist; wobei ein Schaltventil (65) in der ersten Führungsleitung (61) vorgesehen ist; wobei eine zweite Führungsleitung (63) parallel zur ersten Führungsleitung (61) und zur Hauptleitung (52) vorgesehen ist und die Fluidversorgungsquelle (51) mit dem Schaltventil (65) verbunden ist; wobei ein erster Regulator (62) in der ersten Führungsleitung (61) vorgesehen ist, um einen Fluiddruck in der Hauptleitung (52) auf einen geringeren vorbestimmten Druckwert einzustellen; und wobei ein zweiter Regulator (64) in der zweiten Führungsleitung (63) vorgesehen ist, um den Fluiddruck in der Hauptleitung (52) auf einen höheren vorbestimmten Druckwert festzulegen.

10. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß sie außerdem umfaßt:

   eine erste Leitung (78), die mit der Fluidzylindereinrichtung (71) verbunden ist, um ein Fluid von einer Fluidversorgungsquelle (72) der Fluidzylindereinrichtung (71) zuzuführen; ein Durchflußregelventil (80), das in der ersten Leitung (78) vorgesehen ist, um den Druck des Fluids hinsichtlich eines vorbestimmten Werts zu regeln; ein Druckschalter (81), der in der ersten Leitung (78) zwischen der Fluidzylindereinrichtung (71) und dem Durchflußregelventil (80) vorgesehen ist und einen Antriebssignaleregulierungsschnitt (38) aktiviert, um die Walzenantriebeinheiten (14, 15) dann zu betätigen, wenn der Druck in den Zylindern einen erforderlichen Wert erreicht hat, und den Antriebssignaleregulierungsschnitt deaktiviert, wenn der Druck in den Zylindern unter den erforderlichen Wert fällt; ein Schaltventil (77), das in der ersten Leitung (78) vorgesehen ist; ein erstes Druckminderungsventil (78a), das in der ersten Leitung (78) zwischen dem Schaltventil (77) und dem Durchflußregelventil (80) vorgesehen ist; eine zweite Leitung (79), die parallel zur ersten Leitung (78) vorgesehen ist und das Schaltventil (77) mit dem Durchflußregelventil (80) verbindet; ein zweites Druckminderungsventil (79a), das in der zweiten Leitung (79) zwischen dem Schaltventil (77) und dem Durchflußregelventil (80) vorgesehen ist; und einen Druckregulator (75), der zwischen der Fluidversorgungsquelle (72) und dem Schaltventil (77) vorgesehen ist, um den Fluiddruck hinsichtlich eines vorbestimmten Druckwerts zu regulieren.

Revendications

1. Dispositif destiné à enlever un revêtement d’un produit de résine, comportant une unité d’enlèvement de revêtement qui comprend:

   des premier et second rouleaux (12, 11) disposés en parallèle, comportant un écartement de rouleaux entre ceux-ci pour permettre qu’un produit de résine synthétique (Wa) comportant un revêtement (Wc) sur celui-ci passe à travers l’écartement de rouleaux, un moyen d’entraînement de rouleaux (15, 14) destiné à entraîner en rotation lesdits premier et second rouleaux (12, 11) à des vitesses périphériques différentes et dans des directions opposées afin de provoquer une contrainte de cisaillement entre le produit de résine synthétique (Wa) et le revêtement (Wc) qui traversent ledit écartement de rouleaux, en enlevant ainsi le revêtement du produit de résine synthétique, et un moyen de pression (41) destiné à appliquer
Dispositif selon la revendication 1, caractérisé en ce que :

ledit moyen de pression (41) est un moyen de vérin à fluide (43, 71) destiné à appliquer une force de pression de fluide constante prédéterminée,

un commutateur de pression (56) est prévu en vue de détecter une force de pression requise appliquée audit premier rouleau,

un dispositif de commutateur d'actionnement (33, 34) est prévu en vue d'actionner ledit moyen d'entraînement de rouleaux (15, 14) afin d'entraîner en rotation ledits premier et second rouleaux, et

une unité de commande (37) est prévue afin de commander ledit moyen de vérin à fluide (43) et ledit moyen d'entraînement de rouleaux (15, 14) sur la base d'une force de pression détectée par ledit commutateur de pression (56) de telle manière que les produits de résine revêtus (Wa) sont laminés avec ladite force de pression constante prédéterminée maintenue indépendamment des épaisseurs des produits, une contrainte de cisaillement uniforme étant appliquée au revêtement entier et de telle manière que ledit dispositif de commutateur d'actionnement (33, 34) permet d'actionner ledit moyen d'entraînement de rouleaux (15, 14) une fois que la force de pression a atteint ladite force de pression constante prédéterminée et qu'il est désactivé pour actionner ledit moyen d'entraînement de rouleaux (15, 14) si la force de pression n'est pas à ladite force de pression prédéterminée constante.

2. Dispositif selon la revendication 1, caractérisé en ce que ledit moyen de vérin à fluide est un moyen de vérin pneumatique (43).

3. Dispositif selon la revendication 1, caractérisé en ce que ledit moyen de vérin à fluide est un moyen de vérin hydraulique (71).

4. Dispositif selon l'une quelconque des revendications 1 à 3, caractérisé par

une conduite principale (52) reliée audit dispositif de pression à fluide (43) afin de fournir un fluide depuis une source d'alimentation en fluide (51) vers le moyen de vérin à fluide,

une vanne d'ajustement de pression (54) disposée dans ladite conduite principale (52) afin d'ajuster la pression du fluide qui est fourni au moyen de vérin à fluide à une valeur prédéterminée,

le commutateur de pression (56) qui est interposé entre ledit moyen de vérin à fluide (43) et ladite vanne d'ajustement de pression (54) active une section de génération de signal d'entraînement (38) pour actionner les unités d'entraînement de rouleaux (14, 15) lorsque la pression dans les vérins a atteint une pression requise et désactive la section de génération de signal d'entraînement lorsque la pression dans les vérins chute en dessous de la pression requise.

une conduite pilote (57) se raccordant depuis ladite conduite principale (52) et reliant ladite source d'alimentation en fluide (51) à ladite vanne d'ajustement de pression (54), et

un régulateur (58) disposé sur ladite conduite pilote (57) afin de commander la pression du fluide dans la conduite pilote (57) à une valeur prédéterminée.

5. Dispositif selon l'une quelconque des revendications 1 à 4, caractérisé en ce que ledit dispositif de commutateur d'actionnement comprend une paire de commutateurs d'actionnement pouvant être mis en oeuvre manuellement (33, 34) qui génèrent un signal de début destiné à exécuter une opération d'enlèvement du revêtement du produit de résine lorsque les deux commutateurs d'actionnement sont simultanément enfoncés.

6. Dispositif selon la revendication 5, caractérisé en ce qu'une paire de commutateurs d'arrêt d'urgence pouvant être mis en oeuvre manuellement (35, 36) est prévue de façon adjacentes auxdits commutateurs d'actionnement (33, 34) afin de délivrer un signal d'arrêt afin d'arrêter l'opération d'enlèvement lorsque l'un ou l'autre des commutateurs d'arrêt d'urgence est mis en oeuvre.

7. Dispositif selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'une seconde unité d'enlèvement de revêtement (120) identique à ladite unité d'enlèvement de revêtement (110) est prévue, et un moyen d'acheminement (130) est disposé entre les écartements de rouleaux des deux unités d'enlèvement de revêtement (110, 120), afin d'acheminer les produits de résine depuis ladite unité d'enlèvement de revêtement (110) vers ladite seconde unité d'enlèvement de revêtement (120).

8. Dispositif selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'il comprend en outre :

un troisième rouleau (17) disposé de façon adjacente audit second rouleau (11) afin de définir entre ceux-ci un autre écartement de rouleaux à travers lequel lesdits produits de résine synthétique (Wa) qui sont passés à travers ledit écartement de rouleaux, sont amenés à pas-
un moyen d'entraînement destiné à entraîner en rotation le troisième rouleau (17) à une vitesse périphérique différente de celle du second rouleau (11) et dans une direction opposée à celle dudit second rouleau (11), un second moyen de vérin à fluide (43) destiné à appliquer une seconde force de pression prédéterminée au troisième rouleau (17) afin de solliciter le troisième rouleau vers le second rouleau (11), et une unité de commande destinée à commander le second moyen de vérin à fluide (43) afin d'amener la seconde force de pression à prendre une valeur constante prédéterminée de sorte que les produits de résine revêtus sont laminés avec une force de pression fixe indépendamment des épaisseurs des produits de résine revêtus afin d'appliquer ainsi une contrainte de cisaillement uniforme à la surface entière du revêtement.

une conduite principale (52) reliée audit dispositif de pression pneumatique (43) afin de fournir du fluide depuis une source d'alimentation en fluide (51) vers le moyen de vérin à fluide, une vanne d'ajustement de pression (54) disposée sur ladite conduite principale (52) afin d'ajuster la pression du fluide qui est appliquée au moyen de vérin à fluide, à une valeur prédéterminée, un commutateur de pression (56) qui est interposé entre ledit moyen de vérin à fluide (43) et ladite vanne de commande de débit (80) afin d'actionner les unités d'entraînement de rouleaux (14, 15) lorsque la pression dans les vérins a atteint une pression requise et désactive la section de génération de signal d'entraînement lorsque la pression dans les vérins chute en dessous de la pression requise, une vanne de basculement (77) prévue dans ladite première conduite (78), une première vanne de réduction de pression (78a) disposée dans ladite première conduite (78) entre ladite vanne de basculement (77) et ladite vanne de commande de débit (80), une seconde vanne de basculement (77) reliant ladite vanne de basculement (77) à ladite vanne de commande de débit (80), une première vanne de réduction de pression (79a) disposée dans ladite seconde conduite (79) entre ladite vanne de basculement (77) et ladite vanne de commande de débit (80), un régulateur de pression (75) disposé entre ladite source d'alimentation en fluide (72) et ladite vanne de basculement (77) afin de commander la pression du fluide à une valeur de pression prédéterminée.
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**FIG. 8**

**FIG. 9**