United States Patent

Alexander

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[54] METHOD AND APPARATUS FOR ADHERING FOIL TO A SURFACE

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[73] Assignee: **Admiral Coated Products, Inc.**

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[52] **U.S. Cl.**.....**156/247,** 156/540, 156/344, 156/584, 156/233, 156/238

[51] **Int. Cl.**.....**B32b 31/08,** B32b 31/20

[58] **Field of Search**.....156/230, 223, 238, 247, 249, 156/344, 540, 584

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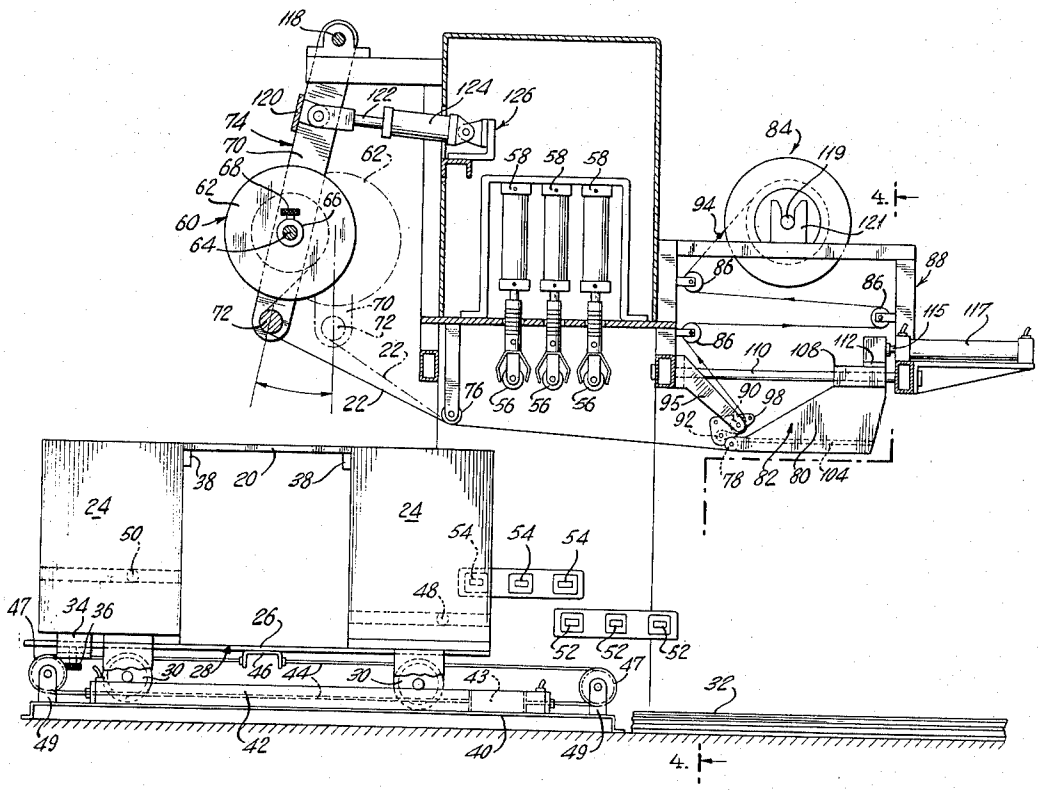
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[57] **ABSTRACT**

A method and apparatus for adhering foil to a given surface. The foil is initially supported at one face of a flexible carrier which must be stripped from the foil subsequent to the adhering thereof to the surface. The foil is adhered to the surface by heat-ironing brought about through suitable rollers, and subsequent to the adhering of the foil to the surface the carrier is continuously wound onto a stake-up roll so that the carrier is progressively from the foil to carry out the stripping operations. These stripping operations are brought about in part by movement of the surface and foil with respect to a stripping roll and in part by movement of the stripping roll with respect to the surface to which the foil is adhered, so that the extent to which the surface and foil must be fed is diminished by the extent to which the stripping roll is moved with respect to the surface and the foil adhering thereto. Also the carrier and foil are derived from a supply roll supported on a swingable frame which moves the supply roll from a given starting position to a given end position during the adhering of the foil to the surface, and a return structure returns the swingable frame back to its starting position after the operations are completed, so that in this way the edge of the foil which is first displaced toward the surface is backed up from the region of the last of the series of heat-ironing rollers to the region of the first thereof, thus reducing waste of foil.

8 Claims, 15 Drawing Figures



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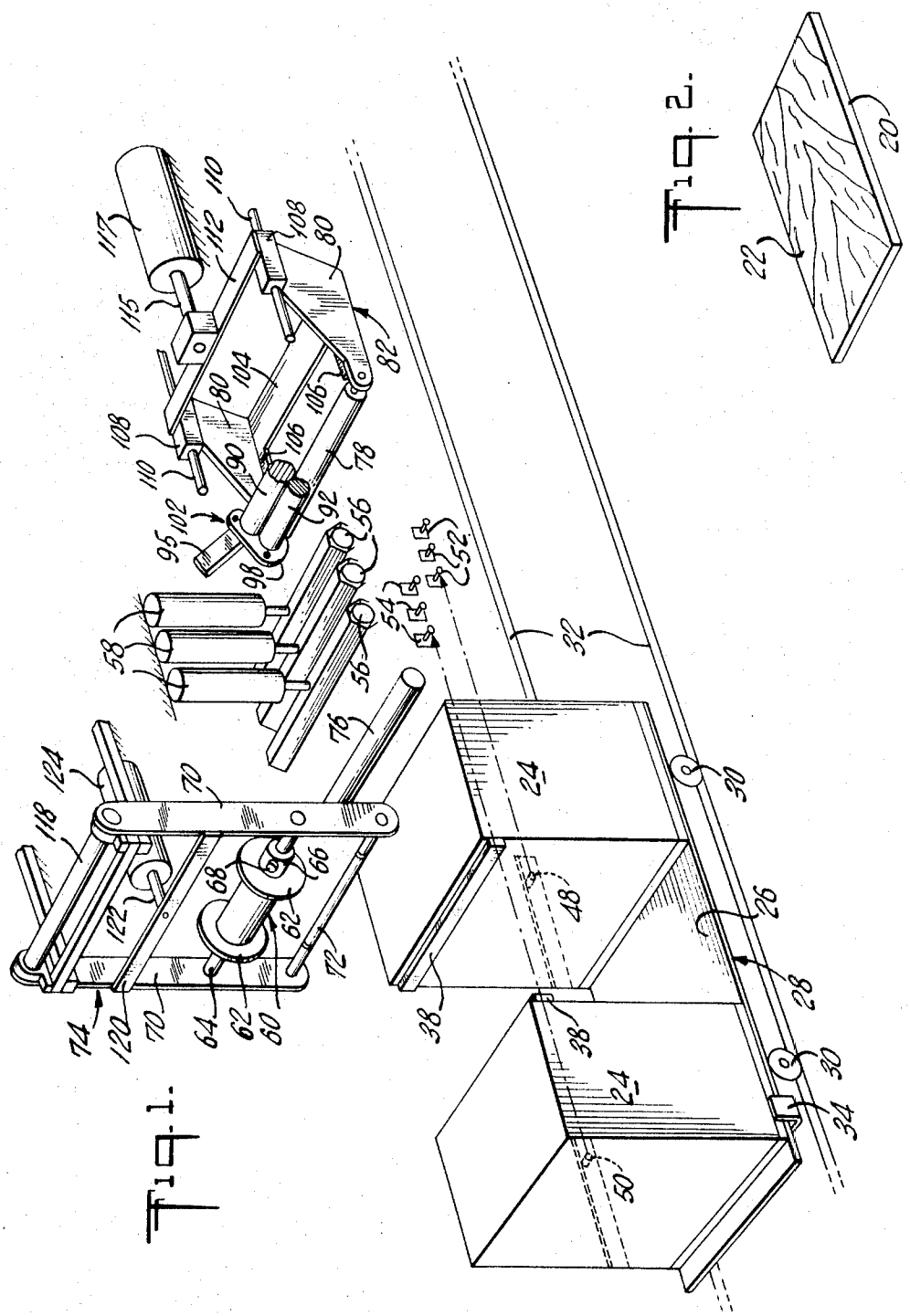


FIG. 1.

FIG. 2.

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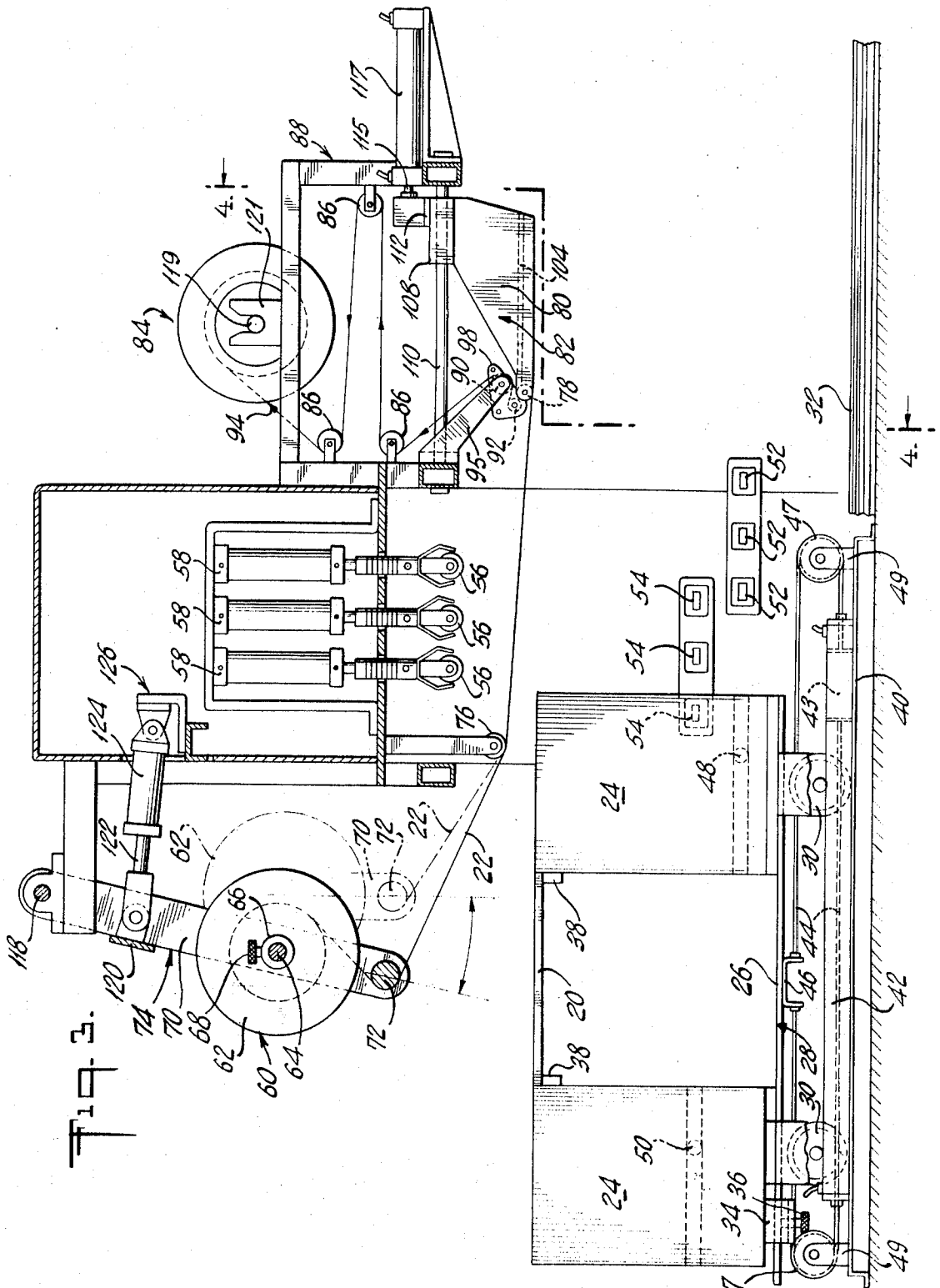


FIG. 3.

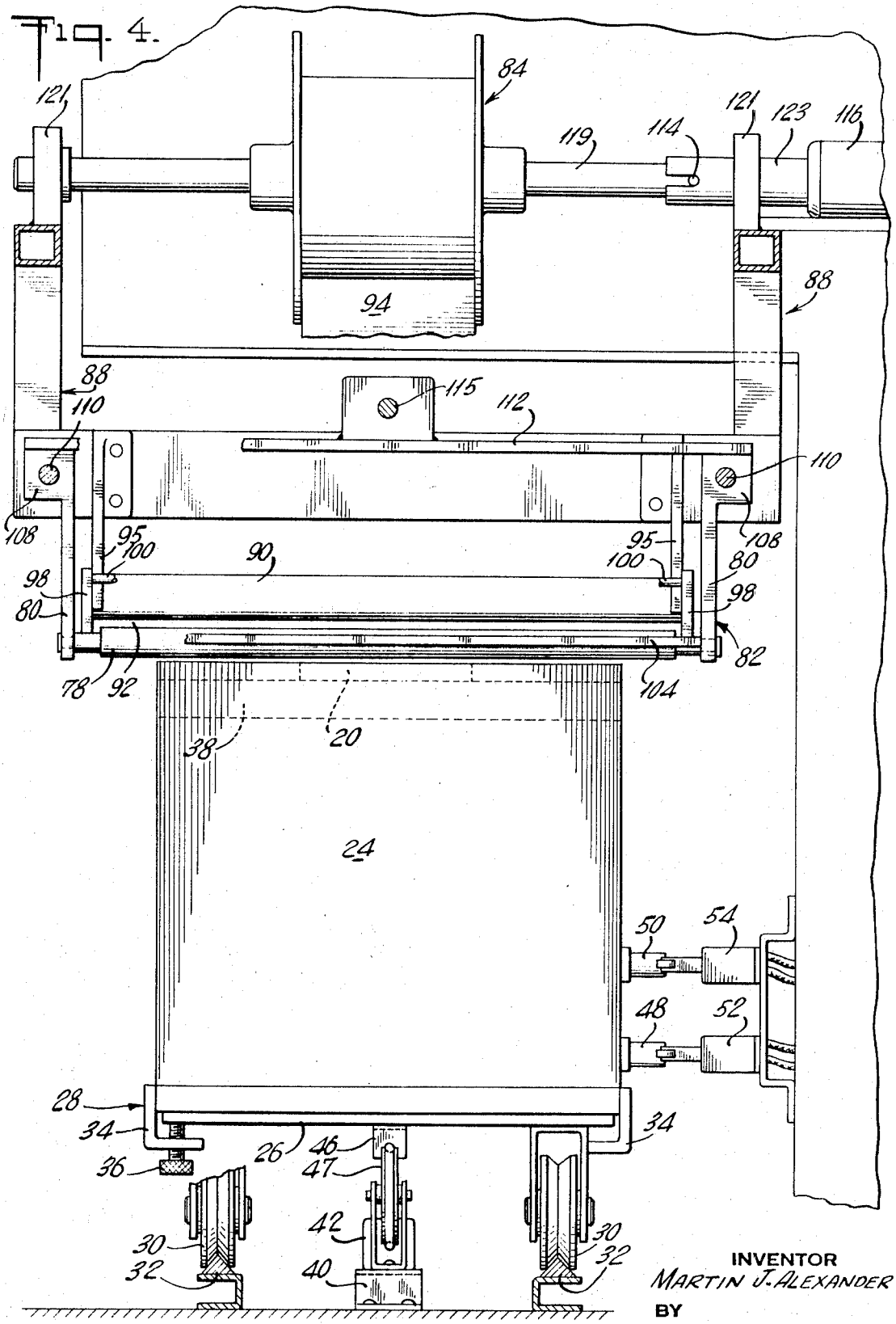
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Fig. 4.



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Fig. 5.

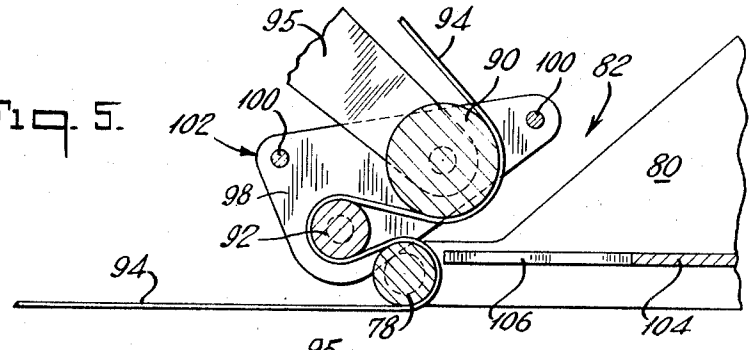
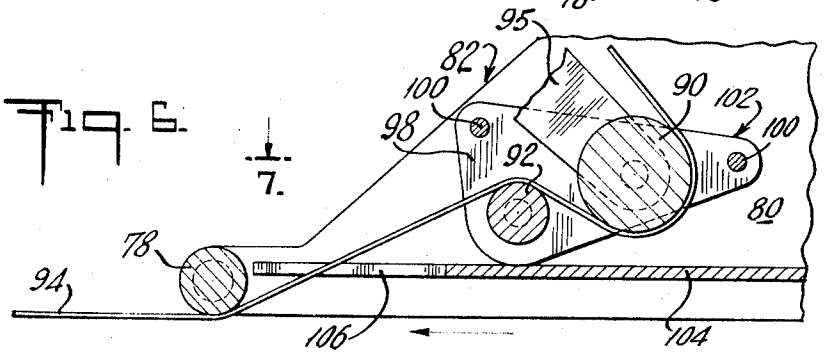
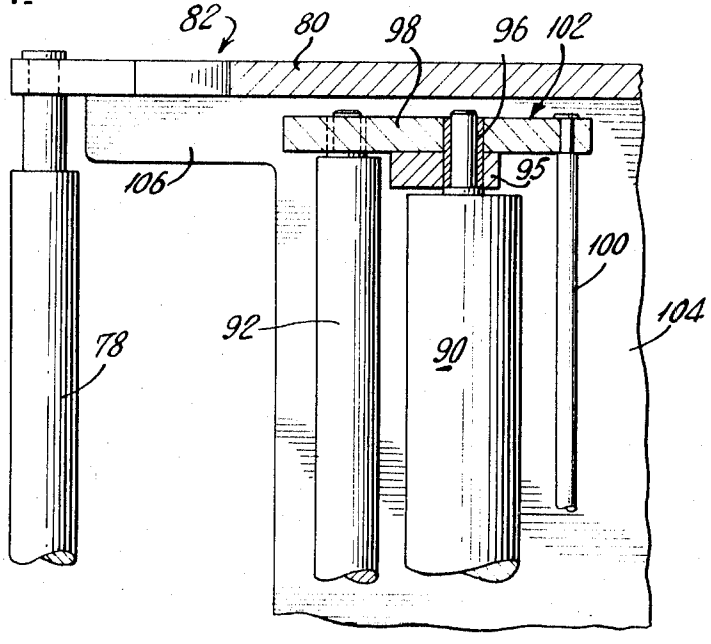


Fig. 6.



7. 7.

Fig. 7.



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FIG. 8.

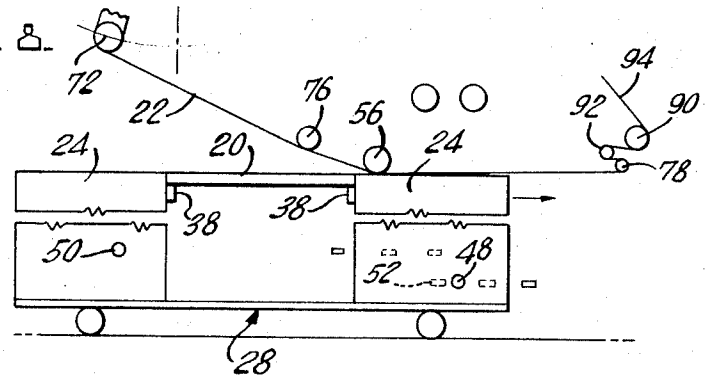


FIG. 9.

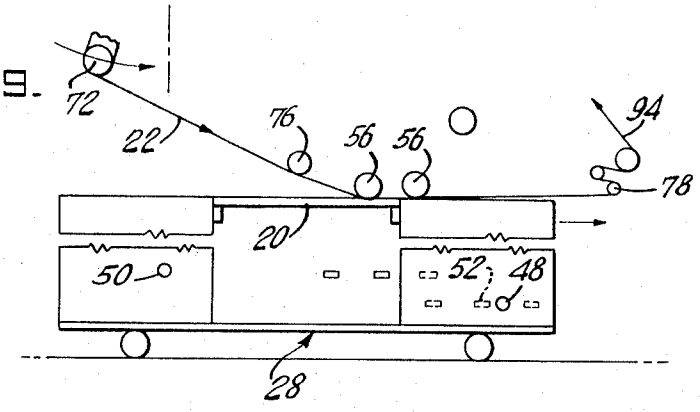


FIG. 10.

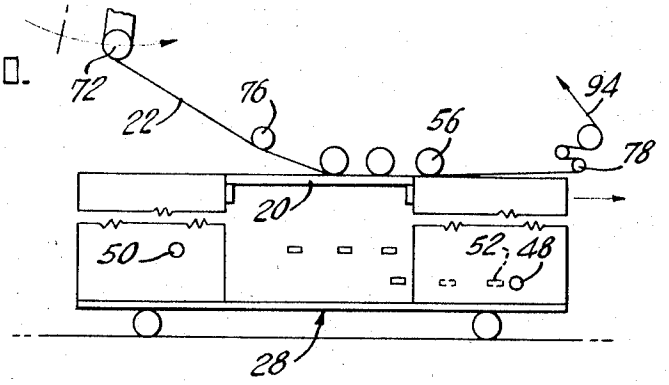
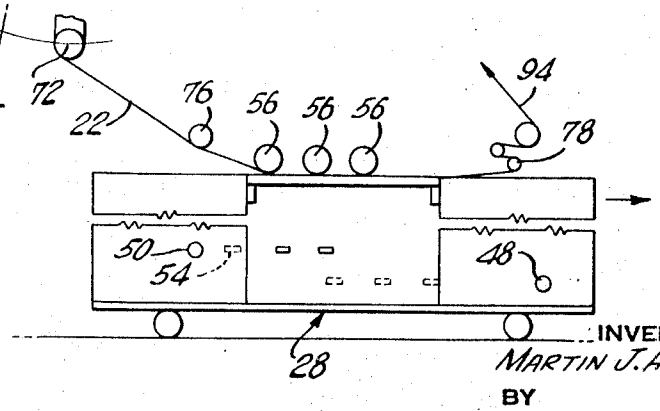


FIG. 11.



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Fig. 12.

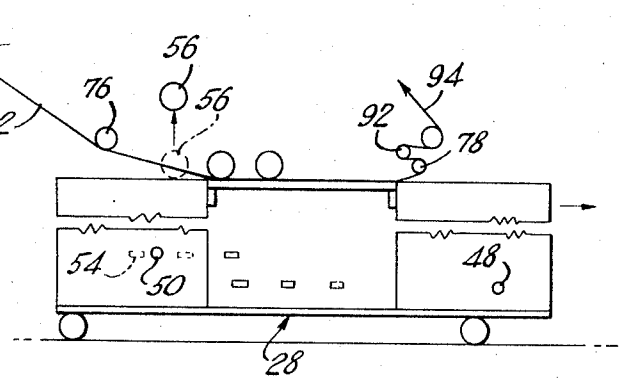


Fig. 13.

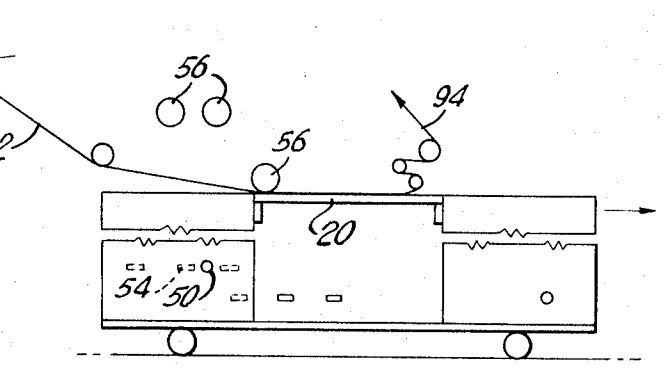


Fig. 14.

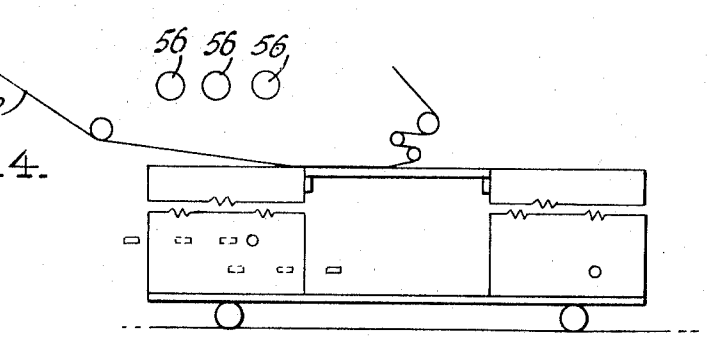
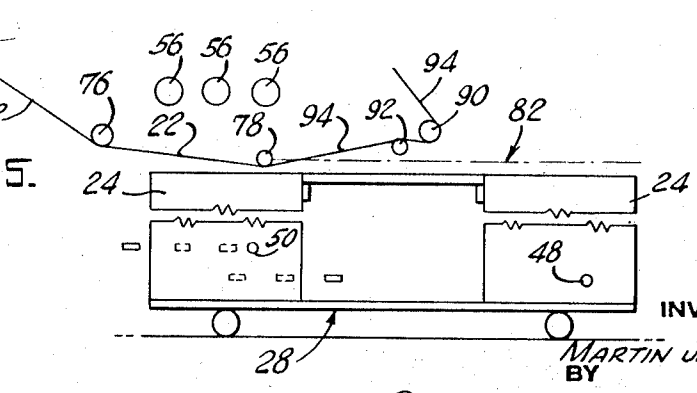


Fig. 15.



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METHOD AND APPARATUS FOR ADHERING FOIL TO A SURFACE

BACKGROUND OF THE INVENTION

The invention relates to a method and apparatus for adhering foil to a given surface.

For example, the invention may be used for adhering decorative foils simulating wood grains, for example, to the outer surfaces of cabinets used for television sets and the like.

At the present time it is known to apply heat and pressure to the foil for adhering the latter to a surface. The heat-ironing operations are provided by way of suitable rollers which may act sequentially to bring about the adhering of the foil to the desired surface. The foil is conventionally carried by one face of a flexible carrier which must be stripped from the foil subsequent to the adhering of the latter to the surface. During conventional stripping operations it does not infrequently happen that the foil is damaged resulting in an undesirably large number of rejects. One of the primary factors resulting in this undesirable action is the "snatching" of the carrier from the foil in a manner which, while intended to save time and increase production, results in frequent damaging of the foil with consequent undesirable rejects.

Furthermore, it is often necessary to situate the apparatus in a limited space which is not always sufficiently great to accommodate an apparatus of a given length.

Also, the foil is pressed with heat against the surface by the sequential action of a series of rollers so that at the end of an operation the terminal edge of the foil is located in the region of the last of the series of rollers while the foil is initially applied to the surface by the first of the series of rollers, resulting at least in wasting of foil to the extent of the distance from the first to the last of the series of rollers. This waste of foil also is highly undesirable because the repeated non-use of a given increment of foil adds up to a considerable amount of waste, with consequent lack of economy.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a method and apparatus which will avoid the above drawbacks.

In particular, it is an object of the present invention to provide a method and apparatus which will enable the carrier to be stripped from the foil after adhering of the latter to the surface, in such a way that the possibility of damage to the foil and rejects is very greatly reduced.

Also, it is an object of the invention to provide the method and apparatus which will enable the stroke through which parts must be advanced to be substantially shortened, so that in this way the structure can be situated in a relatively short space and at the same time the parts can be moved through relatively short distances with consequent advantages.

Furthermore, it is an object of the invention to provide a method and apparatus which will enable waste of the foil to be greatly reduced.

In general it is an object of the invention to provide a method and apparatus capable of accomplishing the above objects while at the same time being very reliable in operation with considerable advantages achieved not only by increased efficiency and economy but also by reason of the rapidity of the operation which enables high outputs to be achieved.

According to the method and apparatus of the invention, during a given cycle of operations the carrier is continuously wound up onto a take-up roll while the carrier is progressively peeled from a foil which has just been adhered to a given surface, so that in this way a possibility of damage to the foil is greatly reduced and a high output is achieved by way of the continuous operation. The stripping of the carrier from the foil takes place on one hand during movement of the foil and surface with respect to a stripper roll and on the other hand during movement of this latter stripper roll with respect to the foil and the surface to which it adheres, so that as a result of these combinations of movements it is possible for the strokes through which the components are moved to be reduced and the space which is required to accommodate the apparatus can also be reduced. Furthermore, the carrier with the foil carried thereby are derived from a supply roll supported on a swingable frame which during application of the foil to the surface swings in one direction from a given starting position to a given end position. At the end of the cycle of operations the swingable frame is returned from its end position to its starting position, with the result that the edge of the foil which is to be applied to the next surface is backed up in a manner which will greatly reduce the extent to which foil is wasted, so that in this way also substantial economies are achieved with the method and apparatus of the invention.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. **1** is a schematic perspective illustration of an apparatus of the invention which is adapted to carry out the method of the invention;

FIG. **2** is a perspective illustration of a workpiece which has foil adhered to a surface thereof;

FIG. **3** is a partly sectional side elevation of the apparatus of the invention schematically illustrating various parts thereof;

FIG. **4** is a fragmentary transverse end view of the structure of FIG. **3** taken along line **4—4** of FIG. **3** in the direction of the arrows;

FIG. **5** is a fragmentary longitudinal sectional illustration of a stripper roll and guide rolls used in the stripping of the carrier and the guiding of the latter to a take-up roll;

FIG. **6** shows the position which the parts of FIG. **5** take after a shifting means of the invention has acted on the stripper roll and a cam means has acted on a cradle which carries the first of the series of guide rolls;

FIG. **7** is a fragmentary plan view of the parts shown in FIG. **6**, taken along line **7—7** of FIG. **6** in the direction of the arrows; and

FIGS. **8–15** respectively illustrates schematically positions which the apparatus of the invention takes during successive steps in the operation of the apparatus to carry out the method of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring first to FIG. **2**, there is illustrated therein a plate or wall **20** which has a foil **22** adhered to its upper surface, as viewed in FIG. **2**. This plate or wall **20** forms the work which is treated with the method and apparatus of the invention. It may be a wall of a cabinet such as a television cabinet or it may be any flat plate on which a foil is to be provided. In the illustrated example the foil **22** is in the form of a thin coating which simulates wood graining. It is capable of being adhered to the upper surface of the plate **20** by application of heat and pressure, so that the foil **22** is heat-ironed to the upper surface of the plate **20**, in a well-known manner where this action is conventional. Initially the foil **22** is carried by one surface of a flexible carrier through which the heat and pressure are applied to the foil **22** and this carrier must be stripped from the foil **22** after the latter is adhered to the plate **20**. It is during the operations in connection with stripping of the carrier from the foil that great care must be exercised to prevent damage to the foil, and this is one of the problems which is solved by the present invention.

Referring to FIG. **1**, the work **20** will be supported on any suitable framework such as one which is made up of a pair of box-shaped units **24** fixed at a given distance from each other on the platform **26** of a carriage **28** which has wheels **30** riding on tracks **32**. As is particularly apparent from FIGS. **3** and **4**, the work supports **24** fixedly carry at their lower side edges angle members **34** provided with clamping screws **36** which press against the bottom surface of the platform **26** so that is this way the supports **24** can be fixed at a selected distance from each other on the platform **26**. FIG. **4** also illustrates the

V-grooves of a corresponding cross-sectional configuration. The supports **24** respectively carry at their ends which are directed toward each other a pair of work-engaging substantially rigid strips **38** on which the opposite ends of the plate **20** rest. The plate **20** is shown in this position in FIG. **3**. Thus, the supports **24** will be spaced from each other by a distance corresponding to the length of the plate **20** in the particular example illustrated.

Although various arrangements could be used to move the carriage **28** along work and return strokes, in the illustrated example a suitable support **40** fixedly carries a cylinder **42** which houses a reciprocating piston **43** having cables **44** secured to the opposite ends thereof. The opposite ends of the cables **44** are secured to bracket **46** fixed to the carriage **28**, the cables being trained over companion pulleys **47** carried by brackets **49** secured to the support **40**. In response to the action of a hydraulic or pneumatic fluid under pressure against piston **43**, the carriage **28** and the structure therein can be moved through a given work stroke and then can be quickly returned through a corresponding return stroke through cables **44** connected to the carriage.

The forward carriage **24** carries a switch-actuating projection **48**, and the rear support **24** carries a switch-actuating projection **50** which is at an elevation higher than the projection **48**. While the elevations of the projections and **50** may remain unchanged, these projections can be adjustably fixed in any suitable way to the supports **24** at preselected positions therealong, in the direction of movement of the carriage **28**, so that in this way proper timing can be achieved for a given job. A suitable control assembly which is situated to one side of the tracks **32** carries a series of three switches **52** to be successively actuated by the projection **48** and a series of three switches **54** to be successively actuated by the projection **50**. Thus, these switches are situated in the path of movement of the projections **48** and **50** to be actuated thereby, as is particularly apparent from FIGS. **1, 3**, and **4**.

The supporting structure extends over the work **20** and carries, in the illustrated example, three silicon covered rollers **56** of various durometers which form the roller means for achieving the heat-ironing of the foil **22** to the surface, such as the surface of the plate **20** in the illustrated example. These rollers **56** are interchangeably carried in a known way on suitable supports so that one set of rollers may be changed for rollers of different durometers and diameters, as required for the treatment of different materials. The heating and ironing rollers through which the heat and pressure is applied to the foil are heated in a purely conventional manner and are actuated also pneumatically or hydraulically by way of the fluid-pressure units **58**. The manner in which the rollers **56** are supported enables them to conform them to any slight variations in the surface of the work so that the foil will be reliably adhered thereto. Inasmuch as the heat-ironing rollers **56** and the structure **58** for actuating these rollers is conventional and well-known, further details thereof are not described.

In a manner which is well-known in the art when the projection **48** actuates the first switch **52**, which is the left switch **52** of FIGS. **1** and **3**, the left roller **56** will be advanced downwardly to apply heat and pressure through the carrier to the foil for adhering the latter to the upper surface of the work **20**. During engagement of the second and third switches **52** the second and third rollers **56** will be advanced downwardly to their working positions. When the switch-actuating projection **50** engages the first of the switches **54**, which is the left switch **54** of FIGS. **1** and **3**, the first or left roller **56** will be returned upwardly to its rest position and the successive actuation of the next switches **54** will bring about the successive return of the next following rollers **56** to their initial rest positions. Inasmuch as these controls and operations also are conventional they are not further described.

As was indicated above, the foil **22** is initially carried by a flexible carrier in the form of a plastic sheet material, for example, which have the same width as the foil **22** and which has the latter temporarily joined to a surface of the carrier which is directed downwardly toward the work during the operations. This composite carrier and foil strip is derived initially from a supply roll **60** which is in the form of a spool having a hollow tubular core on which the composite carrier and foil are initially wound. This spool has a pair of end flanges **62** and a rod **64** is passed through the hollow core of the spool in order to support the latter. The left flange **62** of FIG. **1** engages a collar which is fixed to the rod **64** and which is not visible, while a sleeve **66** is fixed on the rod **64** by way of a set screw **68**. The sleeve **66** is pressed against the right flange **62** of the spool, as viewed in FIG. **1**, in such a way that a given frictional resistance to turning of the spool is achieved by rubbing of the flanges against the collar and sleeve. The rod **64** is releasably fixed to a pair of side bars **70** which form part of a swingable frame of the invention for a purpose described below.

From the spool **60** the carrier and foil composite strip is guided around a lower rod **72** carried by the side bars **70** of the swingable frame **74**, and from the rod **72** the composite carrier and foil strip is directed along the lower part of a guide roller **76** supported for rotary movement on any suitable brackets or bars which are carried by the supporting structure. From the guide roller **76** the composite strip extends beneath the roller means **56** and is guided around a stripping roller **78** supported for free rotary movement between a pair of side walls **80** of a shifting means **82**. The details of the shifting means are described below.

After passing around the stripping roll **78**, the composite strip is guided around a plurality of guide rolls to be directed thereby to take-up roll **84**. Thus, as may be seen from FIG. **3** in particular, there are a plurality of guide rolls **86** supported for free rotary movement about their axes, which remain stationary, on suitable brackets which are fixedly carried by a stationary framework **88** of the apparatus. Between these rolls **86** and the stripper roll **78** is an additional pair of guide rolls **90** and **92**.

As is best shown in FIG. **5**, the carrier **94**, after it is peeled from the foil **22** in a manner described below, extends around the stripper roll **78** and from the latter around the lower guide roll **92** in the manner shown. From the guide roll **92** the carrier is guided around the next upper guide roll **90** so as to extend from the latter to the series of guide rolls **86** shown most clearly in FIG. **3**. In this way the carrier is directed to the take-up spool **84**.

The guide roll **90** is supported for free rotary movement about its axis between a pair of substantially rigid arms **95** carried by the stationary supporting structure. As is most clearly shown in FIG. **7**, the reduced ends of the roll **90** are received in bearing sleeves **96** which respectively extend through aligned opening of a pair of triangular plates **98** which are held together by connecting rods **100** so as to form a cradle **102** which is freely swingable about the axis of the roll **90**. The lower guide roll **92** is supported for free rotary movement between the side plates **98** of the cradle **102**.

The side walls **80** of the shifting means **82** are fixedly connected to each other by a transverse plate **104** which has elongated extensions **106** in the walls **80**. (FIG. **1**.) These extensions **106** and the upper surface of the plate **104** situated behind the extensions **106** form a cam means for a purpose referred to below.

The opposed side walls **80** of the shifting means **82** are fixed at their top ends to axially bored bars **108** through which a pair of horizontal parallel guide rods **110** slidably extend. These rods **110** are fixedly carried by the framework **88**. A transverse bar **112** extends between the bars **108** and has an upwardly extending lug fixed to a piston rod **115** situated in a cylinder **117** adapted to be hydraulically or pneumatically actuated for the purpose of advancing the shifting means **82** first to the left, so that the camming plate structure **104, 106** will cam the cradle **102** into the position indicated in FIGS. **6** and **7**, and of course this fluid-pressure means **115, 117** is also actuated to return the parts to the position shown in FIGS. **1, 3**, and **5**.

As is best seen in FIGS. 3 and 4, the take-up roll 84 is in the form of a spool corresponding to the spool of the supply roll 60 but receiving only the carrier strip 94. The spool 84 is fixed in any suitable way on a rod 119 the left end of which, as viewed in FIG. 4, is freely turnable in an upwardly directed notch of a plate 121 fixed to a bar of the framework 88 in the manner shown in FIGS. 3 and 4. The opposite end of the rod 119 extends into a hollow sleeve 123. This sleeve is provided at its left end, as viewed in FIG. 4, with an axial notch which receives a pin 114 fixed to and projecting laterally from the rod 119 so that the latter is constrained to turn with the sleeve 123. This sleeve 123 is driven through a drive 116 from any suitable motor and gear transmission and including a slip clutch, so that if there is sufficient resistance to movement of the carrier 94 onto the spool 84 the latter together with the rod 119 will not be turned, and in fact with this construction it is possible for the carrier 94 to be advanced in a direction in which it unwinds to some extent from the spool 84, for a purpose referred to below.

In a manner which has been described above the supply roll 60 is carried by the swingable frame 74. The side bars 70 of the frame 74 are pivotally supported at their top ends from a horizontal rod 118 carried by suitable blocks on the framework of the machine. The bars 70 are also interconnected by a transverse bar 120 pivotally connected to a piston rod 122 which is fixed to a piston situated within a cylinder 124 which is supported for swinging movement about a horizontal axis by the assembly 126 shown in FIG. 3. This pneumatic or hydraulic assembly 122, 124 is such that initially it provides only a small resistance to swinging of the frame 70 and the rolls 60 therewith between the starting position shown in solid lines in FIG. 3 and the end position shown in dotted lines in FIG. 3. However, through suitable controls which are not illustrated at the proper time fluid under pressure is introduced into the cylinder 124 to return the frame 74 from its vertical end position to its inclined starting position.

The above-described structure of the invention operates, to carry out the method of the invention, in the following manner:

Assuming that a supply roll is carried by the swingable frame 74 and that the composite strip is threaded through the apparatus in the manner described above so as to be received on the take-up roll 84, then when a cycle of operations is to be carried out the operator will place a workpiece 20 on the ledges 38 between the supports 24 in the manner shown in FIG. 3. With the apparatus thus set up to carry out a cycle of operations, the operator will close a suitable starting switch, and now the apparatus of the invention will operate automatically to carry out the method of the invention. The closing of the starting switch will introduce fluid under pressure into the cylinder 42 so as to push the piston rod 44 to the right, as viewed in FIG. 3, and in this way the working stroke of the work 20 is started. The work 20, and the structure which carries the same, will be advanced along a predetermined working stroke to the right, as viewed in FIG. 3. The projection 48 will first engage the left switch 52, and the result is that the left or first roller 56 is lowered to its operating position. The parts are shown in FIG. 8 at this initial phase of the operations where the projection 48 has just moved beyond the first switch 52, and the first pressure roller 56 has been displaced down to its operating position to commence the heat-ironing of the foil 22 to the plate 20 so as to adhere thereto.

The carriage 28 continues to advance along its working stroke to the right from the position of FIG. 8 to the position of FIG. 9 so that the projection 48 will now actuate the second switch 52, with the result that the next heat-ironing roller 56 is displaced downwardly. It will be noted that in the meantime the work has advanced beneath the first roller 56 which is now directly over the plate 20 inwardly from the leading end thereof.

As was pointed out above, the supply spool 60 is located between a collar and the sleeve 66 in a manner according to which this collar and sleeve frictionally press against the flanges 62 so as to provide a given resistance to turning of the supply roll. This resistance is great enough to prevent winding of the strip onto the take-up roll 84 even though the motor which actuates the drive 116 is operating. In other words the transmission through the unillustrated slip clutch of the drive 116 is such that the force which tends to rotate the take-up spool 84 is not sufficient of itself to unwind the composite strip from the supply roll 60. As a result even though the drive to the take-up spool 84 is operating when the starting switch is turned on, the slip clutch does not transmit a force sufficient to overcome this resistance to turning of the supply roll 60, so that no advance of the composite strip from the supply roll 60 takes place when the parts are in the position of FIG. 3.

However, as soon as the first heat-ironing roller 56 moves down to the operating position shown in FIG. 8, the composite strip is pressed thereby against the top surface of the right support 24 in the region of the leading edge of the work 20, and since the carriage 28 is moving along its working stroke toward the right, as viewed in FIGS. 8 and 9, the presure of the composite strip against the advancing work-supporting structure is sufficient to start the withdrawal of the composite strip from the supply roll 60. Thus, as the carriage now advances beyond the position shown in FIG. 8, the carrier 94 will be fed to the take-up spool 84 while being stripped from the foil 22. Thus, when the parts are in the position shown in FIG. 9 where the second roll 56 has been displaced downwardly to its operating position, the carriage 28 and all of the parts carried thereby continues to move to the right along the working stroke while the first 9 where 56 adheres the foil by heat and pressure to the surface of the work 20 and at the same time the carrier 94 is progressively peeled from the upper surface of the foil and wound onto the take-up spool in a fully continuous manner. The second, intermediate roller 56 repeats the operations performed by the first roller 56 so as to provide additional heat and pressure for increasing the securing of the adhesion derived by way of the first roller 56 and so as to eliminate any slight air pockets which may remain after the work has moved to the right beyond the first or left roller 56.

The operations will now continue with continuous winding of the stripper carrier 94 onto the take-up roll 84. The stripping takes place by a very gradual raising of the carrier first upwardly around the roller 56 of FIG. 8, then upwardly around the next roller 56 shown in FIG. 9, the carrier being guided around the stripping roller 78 which has an elevation which brings about the slight upward incline of the carrier so that it is gradually and progressively peeled from the foil. As may be seen in FIG. 10, during the continued movement of the carriage 28 along its working stroke the projection 48 will actuate the third and last switch 52 so as to cause the third and last roller 56 to move down to the operating position shown in FIG. 10, and now the carrier 94 will move just beyond this last roller 56 upwardly toward the stripping roller 78 and around the latter to progress to the take-up roller 84 in the manner described above.

The operations will now continue through the projection of the parts shown in FIG. 11 where the upper projection 50 has not yet reached the first of the switches 54. Thus, the successive heat-ironing rollers 56 will successively act to provide a very reliable adhesion of the foil to the work with any possible air bubbles or the like completely eliminated, and the carrier is continuously stripped from the foil in the manner described above.

Moreover, as was indicated above, when the operations are started the resistance to movement of the piston rod 122 into the cylinder 124 is relatively small. Therefore when the first roller 56 moves to the position of FIG. 8 the composite strip is compelled to move together with the work 20 without any relative movement between the foil and the work 20 at this time. Because of the relatively low resistance in the fluid-pressure assembly 122, 124 at this time and because of the relatively high friction acting on the supply roll 60 in the manner described above, the swing frame 74 is swung in a counterclockwise direction from the position of FIG. 8, so that the

swing frame **74** starts to swing from its initial starting position toward its vertical end position, and it will be noted that by the time the parts have reached the position shown in FIG. **11** the swing frame **74** has reached its vertical end position, and of course now the pressure provided by way of the rollers **56** is sufficient to overcome the frictional resistance to turning of the roller **60** on the rod **64**, with the result that the composite strip is unwound from the supply spool. The bracket which is connected to the rod **122** engages the left end of the cylinder **124** so as to limit the movement of the swing frame to the vertical end position shown in dotted lines in FIG. **3**, with the frame schematically shown in this position in FIG. **11**.

As soon as the upper projection **50** actuates the first switch **54**, the first roll **56** will be retracted up to its rest position, as indicated in FIG. **12**. It will be noted that this first switch **54** is actuated by the projection **50** only after the work has progressed beyond the first roll **56**. During the continued advance of the carriage **28** the next switches **54** will be actuated by the projection **50**, so that in a well-known manner the next rolls **56** will be successively raised to their initial rest positions, as respectively illustrated in FIGS. **13** and **14**.

As may be seen from FIG. **14**, just after the third and last roller **56** is raised the work still has not advanced to a location where the carrier **94** has been completely peeled from the foil which adheres to the work **20**. However, according to one of the important features of the invention the work stroke is terminated when the carriage **28** reaches the position shown in FIG. **14**. At this time fluid under pressure is introduced into the cylinder **117** so as to displace the rod **115** to the left, as viewed in FIG. **1**, and the result is that the shifting means **82** will now displace the stripper roller **78** to the left. As a result the camming extension **106** of the plate **104** will engage the edge of the side wall **98** which is visible in FIG. **6** to cam the cradle **102** in a clockwise direction from the position of FIG. **5** into the position of FIG. **6**, thus raising the guide roll **92** from the position of FIG. **5** to the position of FIG. **6**. Therefore, immediately after the roller **92** has first been raised by movement of the roller **78** beneath the roller **92** as a result of the action of the fluid introduced into the cylinder **117**, the camming structure **106**, **104** will act on the cradle **102** so as to raise the guide roll **92** further up to the elevation shown in FIG. **6**. At the same time the stripping roll **78** continues to advance to the left along its working stroke, and this stripping roll **78** is advanced in this way all the way up to the position indicated in FIG. **15**. At this the stripping roll **78** is situated beyond the work **20** so that the stripping operations are completed and the composite strip made up of the foil and carrier is now located beneath the stripping roll **78** which is at the end of its stroke in FIG. **15**.

It will be seen that as a result of this feature the stripping operations take place first by movement of the work and foil with respect to the stripping roll and then by movement of the stripping roll with respect to the foil and work. Because of this method and apparatus of the invention, the extent to which the stripping roll **78** is advanced by the shifting means to the left from the position of FIG. **14** to the position of FIG. **15** reduces the required working stroke for the carriage **28** by the same extent. As a result the length required for the entire apparatus can be reduced and it is possible to provide with the structure of the invention a relatively short apparatus which can be accommodated in a small space. Moreover, since the working stroke for the carriage **28** and the parts carried thereby is reduced, with part of the stripping operations taking place by way of the shifting means and the movement of the stripping roll **78**, the movements are distributed among a greater number of elements which consequently wear to a lesser extent, thus increasing the life of the apparatus. Also, as soon as the roll **78** reaches the position of FIG. **15**, the controls can very quickly return the carriage **28** to its starting position, and since this return movement also requires a shorter stroke the time required for return is reduced.

It is to be noted that once the parts have reached the position shown in FIG. **14** where the last roller **56** has been raised the slip clutch and the drive to the take-up roll **84** does not transmit a power sufficient to continue the movement of the carrier **94** onto the take-up roll, so that the unwinding of the strip from the supply roll will terminate when the parts reach the position shown in FIG. **14**. Therefore, the stripper roll **78** in shifting from the position of FIG. **14** to the position of FIG. **15** will simply peel the carrier from the stationary foil until the foil which has not adhered to the carrier rises upwardly away from the left support **24** together with the carrier. At this time the leading edge of the foil will be situated in the region beneath the right or last roller **56** shown in FIG. **15**. THe fluid pressure to the cylinder **117** is now reversed so that the shifting means will be retracted back to its initial position. In this way the stripping roll **78** returns to its initial position shown most clearly in FIG. **5**. Also, at this time fluid under pressure is introduced into the cylinder **124** so as to displace the piston rod **122** to the left, as viewed in FIG. **3**, thus returning the swing frame **74** from its end position to its inclined starting position. Because of the frictional resistance to turning of the supply rolls **60**, the composite strip which extends up to the region beneath the right roller **56** of FIG. **15** and the carrier extending therefrom to the take-up roll are moved in a reverse direction to the left, as viewed in FIG. **15**. The result is that the leading edge of the foil is backed up to become located beneath the first or left roller **56** before the next cycle of operations is started. If this backing up of the leading edge of the foil were not carried out, then the foil would extend beneath the series of rollers **56** when the operations start, so that a length of foil corresponding to the distance between the first and last of the rollers **56** would be wasted at each operating cycle. However, because the leading edge of the foil is backed up from its end position situated beneath the last roll **56** to a starting position situated beneath the first roller **56**, a substantial amount of foil is saved at each cycle of operations, and inasmuch as a large number of these cycles take place, one after the other, a very substantial economy is achieved in this way.

Thus, all of the parts will be returned to their starting positions, the completed work formed by the plate **20** and the foil **22** adhering thereto will be removed, and now a new plate **20** can be placed on the ledges **38** so that the above operations can be repeated.

It will thus be seen that considerable advantage is achieved with the method and apparatus of the invention not only by the continuous winding of the carrier onto the take-up roll during stripping of the carrier from the foil, but in addition, considerable advantages are achieved by the movement of the stripping roll from the position of FIG. **14** to the position of FIG. **15** and by the swinging of the supply roll between its starting and end positions as described above. It is furthermore to be noted that a substantial portion of the carrier is maintained in engagement with the foil after the latter has been adhered to the work by the rollers **56**. Thus, from the first to the last roller **56** there will be a given increment of foil which adheres to the work before the carrier is stripped from the foil, and as the carriage **28** advances from the position of FIG. **10** toward the position of FIG. **11** and beyond to the positions of FIGS. **12–14**, the carrier initially remains in engagement with the foil after moving beyond the last roller **56** because of the slight elevation of the stripping roll **78** so that not only does a gradual peeling of the carrier progressively take place from the foil but in addition this operation provides a curing interval before actual peeling of the carrier from the foil.

What is claimed is:

1. In a method of adhering to a given surface a foil which is initially carried by a flexible carrier at one face of the latter, the steps of heat-ironing the foil to the surface by applying heat and pressure through the carrier to the foil while the foil engages but does not move with respect to the surface, and continuously winding the carrier onto a take-up roll while progressively peeling the carrier from the foil subsequent to heat-ironing thereof to said surface, so that said carrier is progressively stripped from the foil while the latter adheres to

the surface, said heat-ironing being brought about by a plurality of rollers which sequentially bring about heat-ironing of the foil to the surface and with the edge of the foil at the end of one complete cycle of operation being situated in the region of the last of the rollers which is actuated, and backing said edge of the foil to the region of the first of the rollers to be actuated prior to the next operating cycle so that foil waste is reduced.

2. In a method of adhering to a given surface a foil which is initially carried by a flexible carrier at one face of the latter, the steps of heat-ironing the foil to the surface by applying heat and pressure through the carrier to the foil while the foil engages but does not move with respect to the surface, and continuously winding the carrier onto a take-up roll while progressively peeling the carrier from the foil subsequent to heat-ironing thereof to said surface, so that said carrier is progressively stripped from the foil while the latter adheres to the surface, the stripping of the carrier from the foil being carried out in two operations during one of which the surface and foil are moved together with respect to a stripping roll around which the carrier moves to the take-up roll and during the other of which the stripping roll is moved with respect to the surface and foil which remain stationary, during the continuous take-up of the carrier onto the take-up roll, whereby the stroke required for the surface and foil is diminished to the extent that the stripping roll moves with respect thereto during said other operation.

3. In an apparatus for adhering to a given surface a foil which initially is carried at one face of a flexible carrier, feed means for feeding the surface along a given stroke, roller means coacting with said feed means for heat-ironing the foil to the surface during feeding of the latter along said stroke while applying heat and pressure to the foil through the carrier by way of said roller means, and take-up means continuously winding the carrier onto a take-up roll subsequent to heat-ironing of the foil to the surface for continuously peeling the carrier from the foil, said take-up means including a stripper roll around which the carrier extends and guide rolls directing the carrier from the stripper roll to the take-up roll, said feed means feeding the surface through a stroke shorter than the distance required to completely strip the carrier from the foil which adheres to the surface, and shifting means coacting with said stripper roll for shifting the latter through the remainder of said required distance so that the length of the apparatus is shortened to the extent that the stripper roll is moved by said shifting means.

4. The combination of claim 3 and wherein said stripping roll is initially located on one side of the first of the series of guide rolls which receive the carrier from the stripping roll, and cam means actuated by said shifting means and coacting with said first guide roll for camming the latter upwardly to a higher operating position while said stripping roll is shifted by said shifting means beneath and past said first guide roll to the opposite side thereof.

5. The combination of claim 4 and, said combination further comprising a cradle carries said first guide roll and a bracket supports said cradle for swinging movement together with said first guide roll in response to the action of camming means.

6. In an apparatus for adhering to a given surface a foil which initially is carried at one face of a flexible carrier, feed means for feeding the surface along a given stroke, roller means coacting with said feed means for heat-ironing the foil to the surface during feeding of the latter along said stroke while applying heat and pressure to the foil through the carrier by way of said roller means, and take-up means continuously winding the carrier onto a take-up roll subsequent to heat-ironing of the foil to the surface for continuously peeling the carrier from the foil, said roller means including a series of rollers located one after the other along the path of movement of the surface and foil by said feed means, and actuating means cooperating with said series of rollers for subsequently actuating the latter for heat-ironing the foil to the surface by applying heat and pressure to the foil through the carrier by each of said series of rollers.

7. The combination of claim 6, a supply roll from which the carrier and foil are supplied, a swingable frame supporting said supply roll for swinging movement toward said roller means, said frame and supply roll swinging from a given starting position to a given end position during heat-ironing of the foil to the surface by said roller means, and return means coacting with said frame for swinging the latter and said supply roll from said end position back to said starting position to reduce the extent to which the foil is wasted.

8. The combination of claim 7 and wherein the distance through which said swingable frame displaces said foil carrier between starting and end positions of said frame and supply roll corresponds approximately to the distance between the first and last of the series of rollers of said roller means.

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