

June 16, 1953

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2,642,030

ROLLER COATING MACHINE FOR RIGID SHEET MATERIAL

Filed July 28, 1949

3 Sheets-Sheet 1

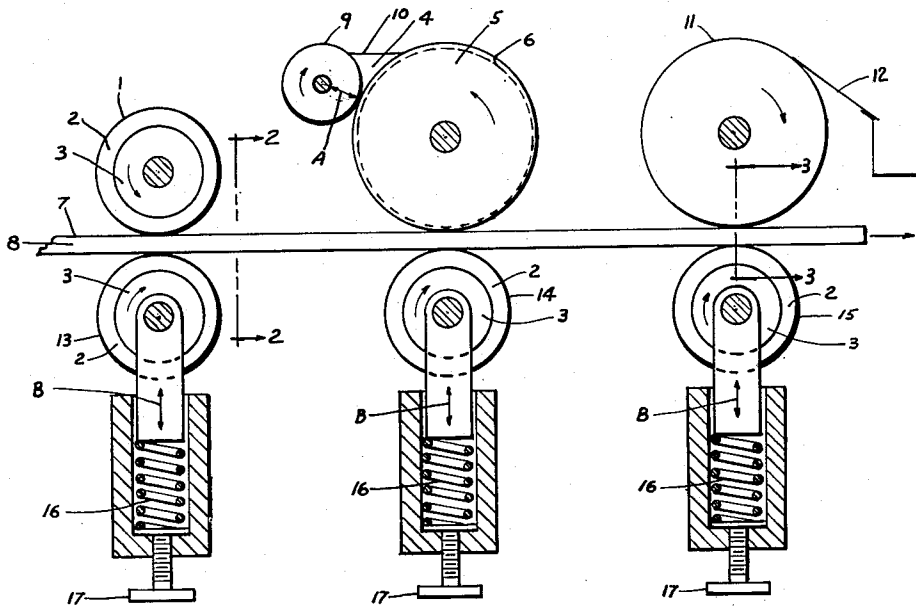


Fig. 1.

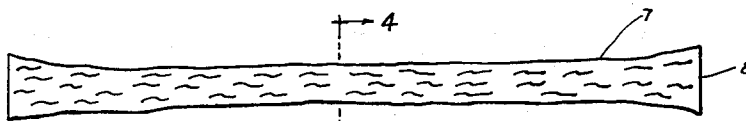


Fig. 2.

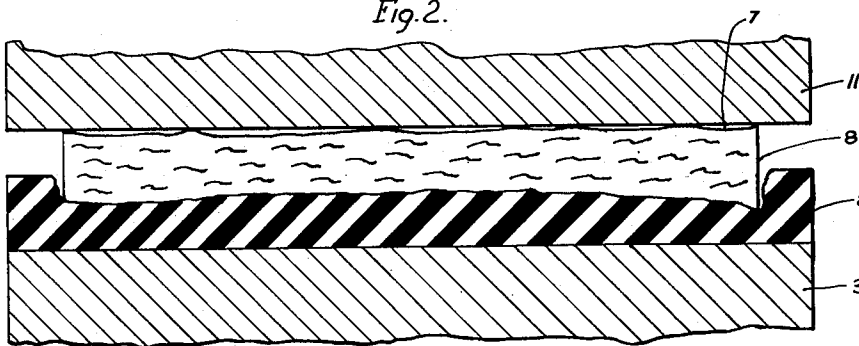


Fig. 3.

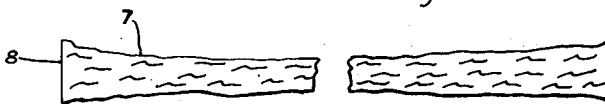


Fig. 4.

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3 Sheets-Sheet 2

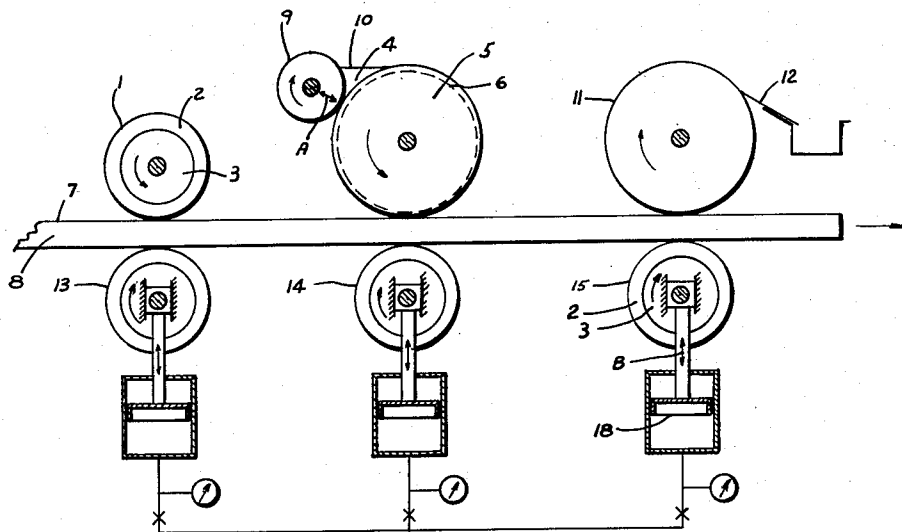


Fig. 5.

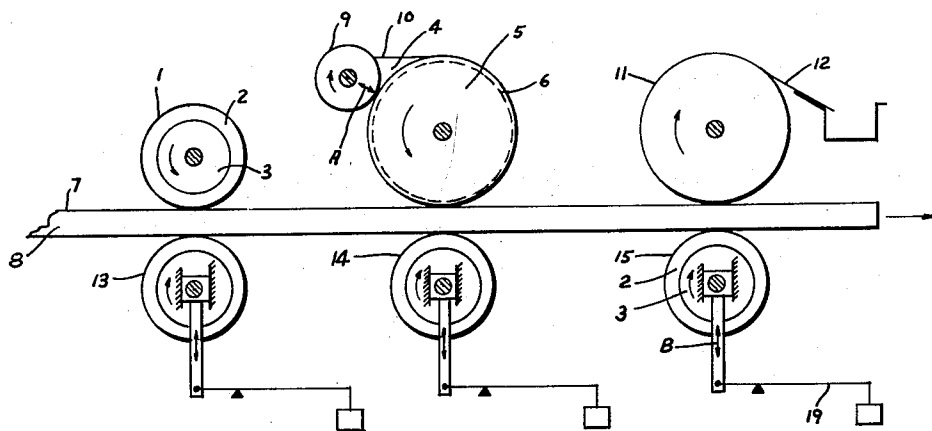


Fig. 6.

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ROLLER COATING MACHINE FOR RIGID SHEET MATERIAL

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3 Sheets-Sheet 3

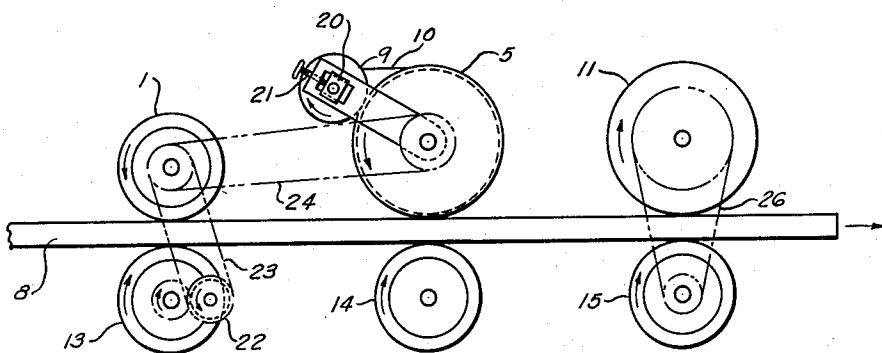


Fig. 7

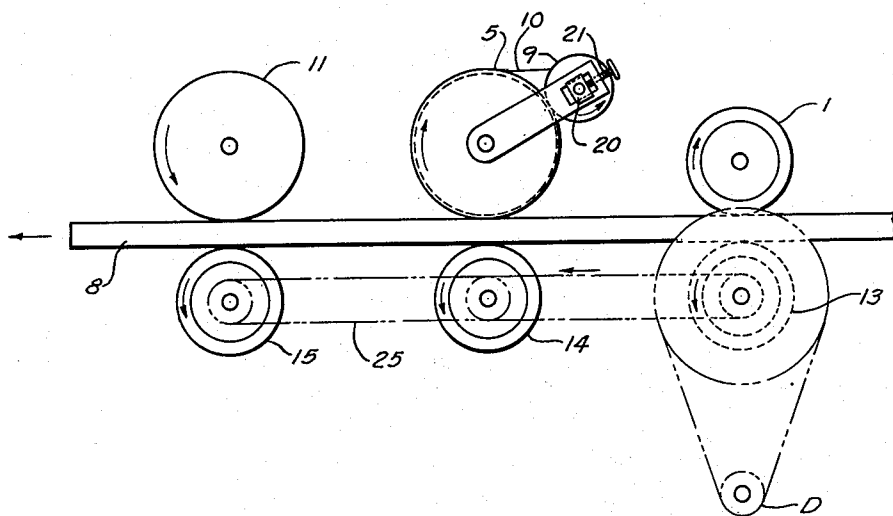


Fig. 8

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ROLLER COATING MACHINE FOR RIGID SHEET MATERIAL

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8 Claims. (Cl. 118—114)

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This invention relates to roll coating machines and more particularly to a roll coating machine which permits application of a smooth coating of uniform appearance on the surface of a rigid sheet material having surface imperfections. By "rigid" is meant sheet materials having substantial thickness and rigidity as distinguished from paper and the like.

There has been a long-felt but heretofore unfilled need for the type roll coating machine of the present invention which enables the application of a smooth coating of uniform appearance to the surface of a rigid sheet material in spite of surface imperfections of the sheet such as e. g. roughness in combination with nonuniform caliper.

Some types of sheet materials have such surface imperfections as a characteristic feature. There are other types of sheet materials which are not ordinarily characterized by these imperfections, but occasionally do have these or similar imperfections to such an extent that they cannot be given a smooth coating of uniform appearance by means of prior art coating machines. Examples of such sheets are "Masonite" hardboards made in accordance with patents such as U. S. Patents 1,663,505 and 2,120,137. So far as known, none of the roll coating machines of the prior art have provision for obtaining a smooth coating of uniform appearance on the imperfect surfaces of such sheet materials.

An object of the present invention is to provide a roll coating machine which enables the application of a coating material to the surface of a rigid sheet material, the finish coat being smooth and of uniform appearance. Another object is to provide a roll coating machine which enables the application of a coating material to the surface of a rigid sheet material having surface imperfections, the finish coat being smooth and of uniform appearance. A further object is to provide a roll coating machine which makes possible the application of a coating material to the surface of a rigid sheet material having rough surfaces and nonuniform caliper, the finish coat being smooth and of uniform appearance. A still further objective is to provide a roll coating machine which makes possible the application of a coating material to a rigid sheet material, having a combination of rough surface and nonuniform caliper, in a manner that effectively counteracts the caliper variations while permitting filling only the low places in the rough surface. Other objects will be apparent from the description of this invention given hereinafter.

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The above objects are accomplished according to this invention by providing and employing a roll coating apparatus comprising means for applying an excess of coating material to the surface of the material to be coated; a wiping roll fixedly journaled; a pressure roll opposed to and cooperating with said wiping roll, the axes of the two rolls being substantially parallel and in a plane substantially perpendicular to that surface of the material being coated, at least the outer portion of the pressure roll being of a resilient material surrounding the roll, the pressure roll being so journaled as to be yieldable in said plane and to exert a substantially constant and uniform pressure; and means for removing the excess of coating material from the wiping roll.

A preferred embodiment of this invention will now be described in more detail with reference to the accompanying drawing. Like reference numerals are used to indicate identical parts.

Referring to the drawing generally:

Figure 1 is a side elevation in partial section showing an apparatus embodying the general aspects of the invention.

Figure 2 is a cross section view along the line 2—2 of Figure 1 of a hardboard in which the imperfections of rough surface and nonuniform caliper are greatly exaggerated to assist in the understanding of the invention.

Figure 3 is a cross section view along the line 3—3 of Figure 1 (coating material on the hardboard not shown).

Figure 4 is a cross section view along the line 4—4 of Figure 2.

Figure 5 is a side elevation showing the pressure rolls mounted on fluid supported pistons as another means of imparting yieldability to said rolls.

Figure 6 is a side elevation showing the pressure rolls provided with weighted lever arms as still another means of imparting yieldability to said rolls.

Figure 7 is a side elevation showing the pressure rolls and chain driving means therefor.

Figure 8 is a side elevation showing the side of the apparatus opposite that shown in Figure 7.

Referring to the drawing in greater detail:

The apparatus according to a preferred embodiment of this invention comprises a drive roll 1 including an outer portion 2 of resilient material such as rubber in the form of a sleeve 2 mounted around a relatively nonresilient core 3; a paint supply trough 4; a coating applicator roll 5 so disposed as to provide one side of trough

4, the surface of which applicator roll is adapted (such as circumferentially grooved surface 6) to pick up coating material, e. g. paint, from the paint supply trough and apply it to that surface 7 of the board 8 being coated; a doctor roll 9 having its axis parallel to and adjustable (as indicated by arrows A) with respect to distance from the axis of the applicator roll, which applicator roll is so disposed as to provide the second side of trough 4; members 10 for closing the ends of trough 4; a smooth hard polished surface wiping roll 11; means 26 for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the board being coated; a doctor blade 12, the drive roll 1 and applicator roll 5 and wiping roll 11 being fixedly journaled; work supporting pressure rolls 13, 14 and 15 opposed to and cooperating with the drive roll 1 and applicator roll 5 and wiping roll 11, respectively, the axis of each pair of said rolls being parallel and in a plane perpendicular to that surface 7 of the board 8 being coated, the outer portion 2 of each of said pressure rolls being of a resilient material such as rubber in the form of a sleeve 2 surrounding the roll, each of the pressure rolls being journaled in a journal box which in turn is mounted on a spring 16 so that each pressure roll is yieldable (as indicated by arrows B) in a plane perpendicular to that surface 7 of the board 8 being coated; set-screws 17 for adjusting the compression of the springs 16; and stops (not shown) to prevent the pressure rolls from contacting their respective opposing rolls in the absence of a sheet material therebetween.

The operation of the above described coating machine now will be further described with reference to coating hardboard. Although this roll coating machine is applicable to coating sheet materials in general, the unusual features of the machine are more fully utilized in coating sheet materials (e. g. hardboards, wallboards, plywood and the like) having surface and caliper variations, and particularly those variations pointed out herein.

Figures 2 and 4 show the surface imperfections encountered in hardboards. These typical imperfections are exaggerated in the drawings to assist in the understanding of the invention. As will be seen from these figures, the caliper of the board varies from side to side and also from end to end, i. e. across the machine direction as well as with the machine direction. Generally the caliper at the center of hardboards is low and the caliper at the edges is high with a gradual substantially uniform change in caliper between low and high caliper. Caliper variations are usually in the order of about .01-.02 inch. From these figures it will also be seen that the surfaces of the board have a series of nonuniform waves. These waves result from normal fluctuations in the conditions used in forming the board. Other surface variations encountered are pits, dimples and cockles. These latter surface imperfections or variations are usually in the order of about .001-.005 inch or greater.

In order to obtain a satisfactorily smooth non-highlighting coating of uniform surface appearance on such a surface, it is necessary to smooth or level out these surface variations without filling in the area between the high caliper points of the board. It has not been found possible to obtain this result with conventional roll coating machines.

In operating the roll coating machine the set-

screws 17 are manually adjusted for the caliper of the board to be coated (e. g. for boards having a caliper of $\frac{1}{16}$, $\frac{1}{8}$ or $\frac{1}{4}$ inch, etc.). Next the board 8 is fed between rolls 1 and 13. In order to give uniform driving friction both rolls 1 and 13 are covered with a rubber sleeve 2, roll 1 is fixedly journaled and roll 13 is yieldably mounted on a spring 16 as indicated by the arrows B. Both rolls 1 and 13 are driven from the common power source D by the chain drive arrangement shown in Figures 7 and 8 in the direction of the board feed and at a predetermined surface speed which determines the feed of the board through the coating machine. The board is driven between spring mounted resiliently sleeved pressure roll 14 and the fixedly journaled applicator roll 5 surface grooved at 6 to pick up and carry enough paint from the paint supply trough 4 to coat the surface 7 of the board 8 with an excess of paint.

The adjustable relationship (as indicated by arrows A) of doctor roll 9 with respect to applicator roll 5 permits control of the wet paint film applied to the applicator roll. The adjustment of doctor roll 9 is controlled by means of the movable journal box 20 and the adjustable screw 21.

Continuing the description of the operation of the roll coating machine, the pressure roll 14 maintains a substantially constant and uniform pressure of the board against the applicator roll 5 and permits good paint coverage of the board surface 7. The relative position of the board and the rolls at this stage is very similar to that shown in Figure 3 of the drawing. The pressure roll 14 pushes up the thin portion of the board and causes the board to more uniformly contact the applicator roll. The pressure roll 14 and applicator roll 5 are driven in the direction of the board feed and at a surface speed synchronized therewith by means of the gear drive 22 and the chain drive mechanisms 23, 24, and 25 respectively.

Next the coated board is driven between spring mounted resiliently sleeved pressure roll 15 and fixedly journaled hard polished surface wiping roll 11. The wiping roll removes the excess paint from the board and smooths the ridges in the paint caused by the applicator roll. The direction and surface speed of pressure roll 15 is the same as that of pressure roll 14. The wiping roll 11 is driven by the chain drive 26 in a reverse direction to that of the board feed and at a surface speed less than that of the board so that there is always a wedging action on the paint which forces it into and fills up the pits and valleys on the surface of the board and at the same time leaves the high spots (ridges and cockles) relatively bare of paint, because about the only paint remaining on the high spots after this operation is that taken up by the surface of the board at these points. Surface speeds of the wiping roll of $\frac{1}{4}$ - $\frac{3}{4}$ the speed of travel of the board have been used with good results. The action of the pressure roll 15 in pushing up the thin portion of the board and causing the board to more uniformly contact the wiping roll is shown in Figures 2 and 3. The doctor blade 12 removes the excess paint from the wiping roll 11 and returns (not shown) the paint for re-use.

Other arrows in the drawing not specifically designated indicate the direction of travel of the board and rotation of the rolls.

When operating such that the surface speed of the wiping roll 11 is about $\frac{1}{4}$ - $\frac{3}{4}$ of the speed

of travel of the board, a slight roll of coating material is maintained at the bite of the wiping roll. This is desirable as a cautionary measure in that if the applicator roll 5 should fail to apply adequate coating material to any area of the surface of the board, the coating material is applied to said area of the board by the wiping roll from said roll of coating material. Perhaps a more important reason for driving the wiping roll at a surface speed less than that of the board is that by so doing it creates a wedging or dragging action between the surface of the board and the bite of the wiping roll which forces the coating material into the low places in the surface of the board. If the surface speed of the wiping roll is substantially outside the range just disclosed, less desirable results are apt to be obtained. With a surface speed substantially less than $\frac{1}{4}$ that of the board travel two difficulties are apt to be encountered. First, an excess roll of coating material accumulates at the bite of the wiping roll. This coating material runs off the edges of the board and makes for an untidy operation. The wiping roll wipes up more coating material than it can carry and this excess falls back on the board. Second, at such speed the wiping roll is more apt to become gummed due to the coating material drying and thereby prevented from doing a good wiping job. If the surface speed of the wiping roll is substantially greater than $\frac{1}{4}$ the speed of the travel of the board, too much of the coating material is wiped off the board. In doing so not only are the high places on the board surface wiped free of coating material but also some coating material is literally pulled out of the low places on the board surface. Obviously this is undesirable. Of course the proper surface speed of the wiping roll will depend on the nature of the material being coated and also the characteristics of the coating material being used.

Thus the board surface is now in a suitable condition for applying a finish by conventional means free from highlighting, waves, cockles, pits and dimples. In other words the finish will be smooth and of uniform appearance. This may be done, e. g. by spraying a primer coat on the board surface following the wiping roll and then baking. The resulting primed surface may then be coated with any desired top coat such as, for example, a lacquer, dry enamel, baking enamel, and the like.

An outstanding and important feature of the present invention is the pressure rolls 13, 14 and 15, of which pressure roll 15 in combination with wiping roll 11 is the most important. Each pressure roll contributes to a more uniform operation and result. The resilient sleeve 2 of each pressure roll in combination with the way in which the rolls are mounted insures excellent contact of the rolls with the surfaces of the board. The resilient sleeve 2 insures excellent contact in spite of surface variations across the board (e. g. transverse caliper variation as shown in Figure 2). The way in which the rolls are mounted insures excellent contact in spite of surface variations along the board (e. g. longitudinal caliper variations as shown in Figure 4). With respect to drive roll 1 and pressure roll 13 this makes for a more uniform travel of the board through the machine in spite of the variations in the board. Regarding applicator roll 5 and pressure roll 14, this makes possible the application of an excess coating of paint in the form of a continuous coat of substantially uniform thick-

ness in spite of the variations in the board. Regarding wiping roll 11 and pressure roll 15, this makes possible filling up the pits and valleys in the board surface without accentuating the ridges and cockles in the board surface in spite of the variations in the board, thereby resulting in a board having a smooth continuous surface; that is the pits and valleys are filled up without accentuating the cockles and ridges and without filling in the area between the high caliper edges. This makes possible the application to said surface of a finish coat having the desirable characteristics hereinbefore described.

An essential feature of this invention is pressure roll 15 in combination with wiping roll 11. At this point of the coating operation the surface of the board has an excess coating of substantially uniform thickness. There is coating material on the high places of the board as well as in the low places. The coating on the board at this stage has ridges in it. The board still has the same caliper variations as it did in the beginning, i. e. thick edges and thin center with a substantially gradual change in caliper from thick edges to thin center. The object at this phase of the invention, notwithstanding the caliper variations in the board, is to provide means to remove the excess coating material and to remove the ridges in the coating so that the dimples and valleys and the like low places in the surface of the board are filled up with coating material and so that the cockles, hills and the like high places in the surface of the board are substantially freed of coating material except that remaining by virtue of surface uptake. In order to accomplish this object the caliper variation both in machine direction and across the machine direction (longitudinal and transverse, respectively, with reference to the board) must be substantially eliminated while the wiping job is being done. In other words, the contact between the surface 7 of the board 8 being coated and wiping roll 11 must be substantially independent of caliper variations in the board during the wiping step. This result is accomplished by the conjoint action of pressure roll 15 and wiping roll 11. The resilient outer portion or sleeve 2 mounted around the relatively nonresilient core 3 of pressure roll 15 in combination with the relatively nonresilient fixedly journaled wiping roll 11 adequately eliminates the transverse caliper variation in the board as shown in Figure 3. The yieldable journaling of pressure roll 15 in combination with said wiping roll 11 adequately eliminates the longitudinal caliper variations in the board. As a result of this arrangement a substantially uniform and constant pressure is maintained on the board between pressure roll 15 and wiping roll 11. By virtue of this arrangement excellent contact is maintained between the surface 7 of the board 8 and the wiping roll 11, which contact is independent of caliper variations. While the caliper variation is eliminated the wiping roll removes the excess coating material from the surface of the board in the manner described above. Without this or an equivalent combination of elements caliper variations would not be sufficiently eliminated and as a result the coating material would be removed only from the high caliper edges of the board. Without the yieldable journaling of pressure roll 15 in combination with the fixable journaling of wiping roll 11 said difficulty would result from the longitudinal caliper variation in the board.

While this invention has been described with reference to the preferred embodiment thereof and while better results are obtained by so practicing the invention, the invention is not limited to this embodiment. Instead of springs 16 for mounting the pressure rolls 13, 14 and 15, any means can be used provided the pressure rolls are yieldable as pointed out hereinbefore. For example the journal box of the pressure rolls can be mounted on fluid supported pistons or a similar result can be accomplished by use of weighted lever arms and the like as illustrated in Figures 5 and 6, respectively.

The excess coating material may be applied to a sheet material by any suitable conventional means (e. g. by spray, doctor blade, brush, etc.) and then the sheet passed between wiping roll 11 and pressure roll 15 or their equivalents. However, substantially better results are obtained by applying the excess coating material by means of the preferred embodiment of the coating machine described herein. The coating applied by the present coating machine is usually referred to in the trade as the base coat. Because of the high solids content (normally about 80% solids or greater) used in the coating material for forming the base coat, the alternate methods just listed for applying an excess of coating material of this nature are less desirable than the method described in more detail hereinbefore.

While this invention is particularly applicable to coating rigid sheet materials having the imperfections hereinbefore described (hardboards, wallboards and plywood being examples of this type sheet material), it is also applicable to coating rigid sheet materials in general.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not to be limited to specific embodiments thereof except as defined in the attached claims.

I claim:

1. Apparatus for coating comprising means for applying an excess of coating material to the surface of a rigid sheet material having rough surfaces and nonuniform caliper; a smooth hard polished surface wiping roll fixedly journaled; a work supporting pressure roll opposed to and cooperating with the wiping roll, the axes of the two rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, at least the outer portion of said pressure roll being of a resilient material, yieldable mountings for said pressure roll so that the roll is yieldable in said plane and exerts a substantially constant and uniform pressure on the sheet; and means for removing the excess coating material from the wiping roll.

2. Apparatus for coating comprising means for applying an excess of coating material to the surface of a traveling rigid sheet material having rough surfaces and nonuniform caliper; a smooth hard polished surface wiping roll fixedly journaled to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a work supporting pressure roll opposed to and cooperating with the wiping roll, the axes of the two rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, at least the outer por-

tion of said pressure roll being of a resilient material, yieldable mountings for said pressure roll so that the roll is yieldable in said plane and exerts a substantially constant and uniform pressure on the sheet; and means for removing the excess coating material from the wiping roll.

3. Apparatus for coating comprising means for applying an excess of coating material to the surface of a traveling rigid sheet material having rough surfaces and nonuniform caliper; a smooth hard polished surface wiping roll fixedly journaled to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a work supporting pressure roll opposed to and cooperating with the wiping roll; the axes of the rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, the outer portion of said pressure roll being of a resilient material in the form of a sleeve mounted around a relatively nonresilient core, said pressure roll being journaled in a journal box which in turn is mounted on means including a spring so that the pressure roll is yieldable in said plane and exerts a substantially constant and uniform pressure against the sheet; and means for removing the excess coating material from the wiping roll.

4. The apparatus of claim 3, and in which there is means for manually adjusting the compression of said spring.

5. Apparatus for coating comprising means for applying an excess of coating material to the surface of a traveling rigid sheet material having rough surfaces and nonuniform caliper; a smooth hard polished surface wiping roll fixedly journaled to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a work supporting pressure roll opposed to and cooperating with the wiping roll; the axes of the two rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, the outer portion of said pressure roll being of a resilient material in the form of a sleeve mounted around a relatively non-resilient core, said pressure roll being journaled in a journal box which in turn is mounted on means including a fluid supported piston so that the pressure roll is yieldable in said plane and exerts a substantially constant and uniform pressure against the sheet; and means for removing the excess coating material from the wiping roll.

6. Apparatus for coating comprising means for applying an excess of coating material to the surface of a traveling rigid sheet material having rough surfaces and nonuniform caliper; a smooth hard polished surface wiping roll fixedly journaled to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a work supporting pressure roll opposed to and cooperating with the wiping roll, the axes of the two rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, the outer portion of said pressure roll being of a resilient material in the form of a sleeve mounted around a relatively

non-resilient core, said pressure roll being journaled in a journal box to which is attached a means including a weighted lever member so that the pressure roll is yieldable in said plane and exerts a substantially constant and uniform pressure against the sheet; and means for removing the excess coating material from the wiping roll.

7. Apparatus for coating the surface of a traveling rigid sheet material having rough surfaces and nonuniform caliper comprising a drive roll, at least the outer portion of which is of a resilient material; coating material supply means; an applicator roll, the peripheral portion of which is adapted to pick up coating material from the coating material supply means and apply to the surface of the sheet; a doctor roll having its axis parallel to and adjustable with respect to distance from the axis of the applicator roll and controlling the film of coating material on the applicator roll; a smooth hard polished surface wiping roll to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a doctor blade for removing the coating material from the wiping roll, said driving roll and applicator roll and wiping roll being fixedly journaled; a work supporting pressure roll opposed to and cooperating with each of said drive roll and applicator roll and wiping roll, the axis of each pair of said rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, at least the outer portion of each of said pressure rolls being of a resilient material, yieldable mountings for said pressure rolls so that the rolls are yieldable in said plane and exert a substantially constant and uniform pressure against the sheet.

8. Apparatus for coating the surface of a substantially rigid sheet material having rough sur-

faces and nonuniform caliper comprising an applicator roll, the peripheral portion of which is adapted to pick up coating material from the coating material supply means and apply to the surface of the sheet; a doctor roll having its axis parallel to and adjustable with respect to distance from the axis of the applicator roll and controlling the film of coating material on the applicator roll; a smooth hard polished surface wiping roll to smooth the ridges of coating material and remove the excess coating material from the sheet; means for driving the wiping roll at a predetermined differential surface speed and in a reverse direction relative to that of the sheet; a doctor blade for removing the coating material from the wiping roll, said driving roll and applicator roll and wiping roll being fixedly journaled; a work supporting pressure roll opposed to and cooperating with each of said drive roll and applicator roll and wiping roll, the axis of each pair of said rolls being substantially parallel and in a plane substantially perpendicular to that surface of the sheet being coated, at least the outer portion of each of said pressure rolls being of a resilient material, yieldable mountings for said pressure roll so that the rolls are yieldable in said plane and exert a substantially constant and uniform pressure against the sheet.

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