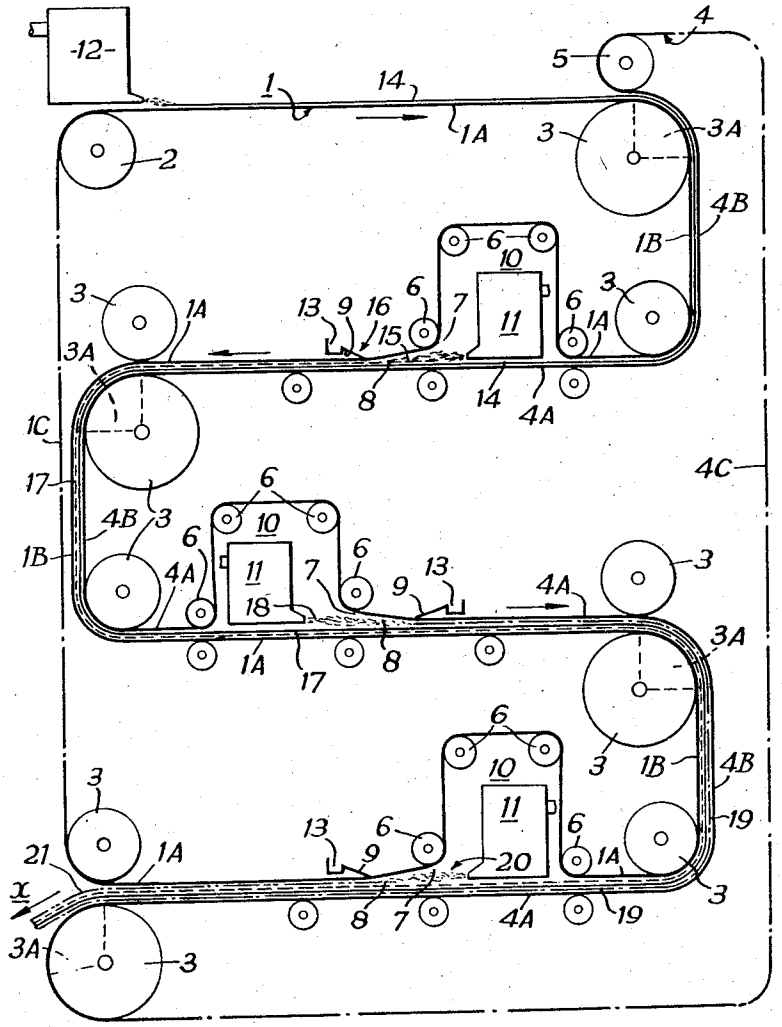
April 14, 1959 R. J. THOMAS 2,881,672

METHOD AND APPARATUS FOR MANUFACTURING PAPER OR FIBROUS BOARD

Filed Oct. 11, 1956 4 Sheets-Sheet 1

Fig. 1.




INVENTOR
REGINALD JAMES THOMAS

BY

Hill, Sherman, Meroni, Gross & Simpson

ATTORNEYS

April 14, 1959 R. J. THOMAS 2,881,672

METHOD AND APPARATUS FOR MANUFACTURING PAPER OR FIBROUS BOARD

Filed Oct. 11, 1956 4 Sheets-Sheet 2

Fig. 2.

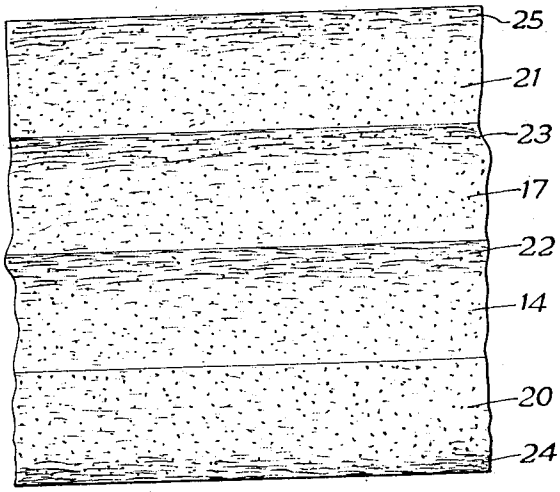
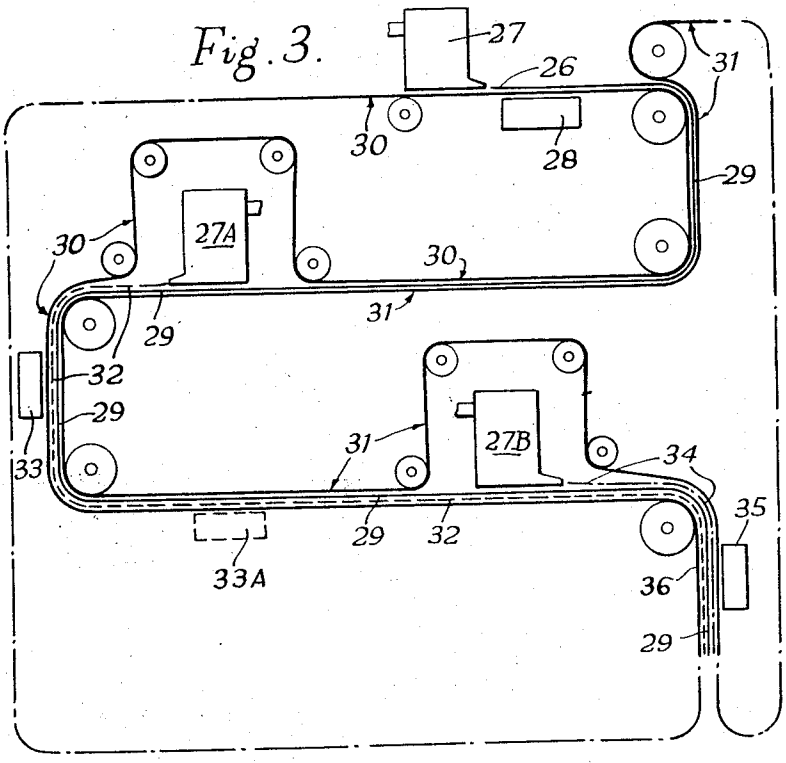



Fig. 3.




INVENTOR
REGINALD JAMES THOMAS
BY
Hill, Sherman, Meroni, Gross & Simpson
ATTORNEYS

April 14, 1959 R. J. THOMAS 2,881,672

METHOD AND APPARATUS FOR MANUFACTURING PAPER OR FIBROUS BOARD

Filed Oct. 11, 1956 4 Sheets-Sheet 3

Fig. 4.

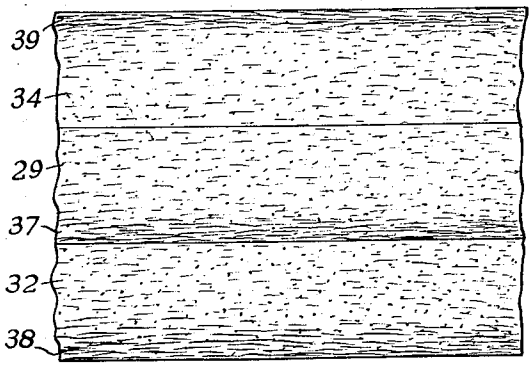
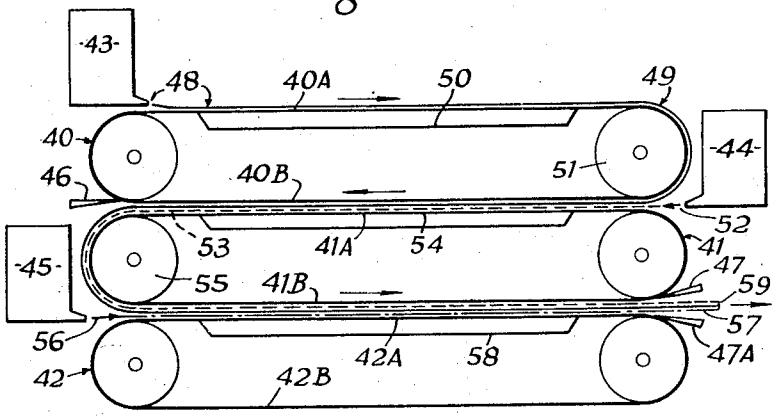



Fig. 5.




INVENTOR
REGINALD JAMES THOMAS

BY

Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

April 14, 1959 R. J. THOMAS 2,881,672

METHOD AND APPARATUS FOR MANUFACTURING PAPER OR FIBROUS BOARD

Filed Oct. 11, 1956 4 Sheets-Sheet 4

Fig. 6.

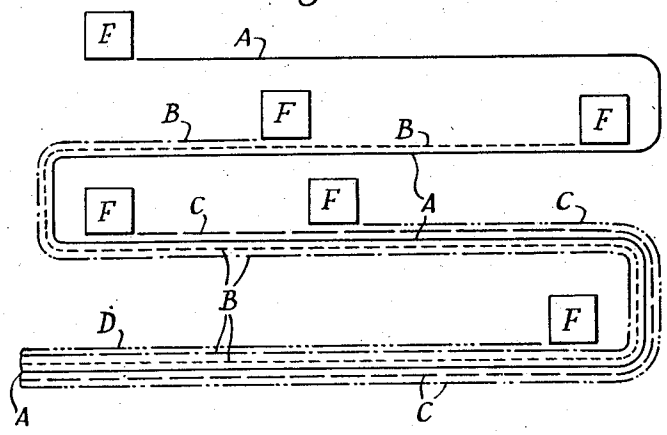



Fig. 7.

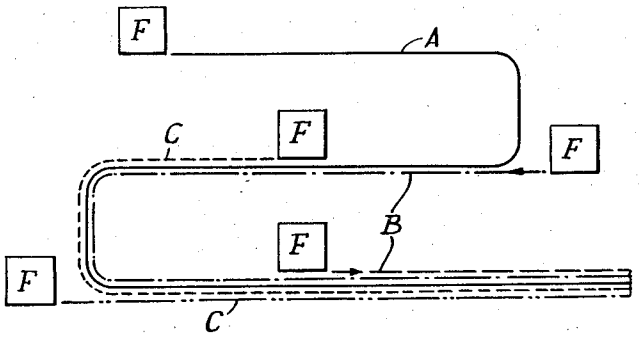
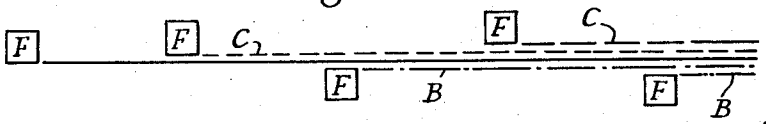



Fig. 8.




INVENTOR
REGINALD JAMES THOMAS

BY

Watts, Hoffman, Fisher & Heinke

ATTORNEYS

United States Patent Office 2,881,672 Patented Apr. 14, 1959



2,881,672

# METHOD AND APPARATUS FOR MANUFACTURING PAPER OR FIBROUS BOARD

Reginald James Thomas, Weston-Super-Mare, Somerset, England, assignor to St. Anne's Board Mill Company Limited, Bristol, England, a British company

Application October 11, 1956, Serial No. 615,322

Claims priority, application Great Britain October 14, 1955

12 Claims. (Cl. 92—39)

This invention relates to improved methods and apparatus for use in the manufacture of paper or paper board or similar fibrous products.

In the manufacture of paper or board, for example by delivering watery pulp onto a travelling carrier band, water is removed from the pulp through the band either by gravity or suction and this acts to bring the long fibres to the surface i.e. into contact with the travelling band. This is an advantage as it can provide enhanced strength and surface characteristics. The surface at which the longer fibres are distributed is commonly referred to as the wire side of the web.

The object of the present invention is to provide apparatus for manufacturing paper or paper board or similar fibrous products having wire sides at both surfaces.

The present invention consists in a method of manufacturing a multi-ply web of paper or paper board or similar fibrous product in which a layer of pulp is formed to provide a base layer and subsequent layers of watery pulp are added thereto, said subsequent layers being added on opposite faces of the base layer and being dewatered from their exposed surfaces so as to provide a multi-ply web.

The expression "base layer" as used herein does not necessarily imply a layer thicker and/or denser than the subsequent layers applied thereto—at least one on each side—but is employed mainly to facilitate a description of the invention and simply means the first layer formed.

If desired two or more subsequent layers may be added in succession to one side of the base layer.

One or more of the subsequent layers may be added to the underside of the base layer.

The base layer with a superimposed formed or unformed layer may be inverted whereupon at least one further layer is delivered on to the opposite face of said base layer.

Alternatively, a formed or unformed layer may be delivered beneath the base layer and said two layers inverted, whereupon at least one further layer is delivered to the opposite face of said base layer.

Preferably each subsequent layer is dewatered through a permeable member moving with said exposed face whereby the layers form against said member.

The base layer with a further formed or unformed layer on one face may be sandwiched between permeable travelling carrier bands which are adapted to invert the said two layers, whereupon a further layer is delivered to the opposite face of the base layer to provide a three-ply web.

A further formed or unformed layer or layers may be added on one or both faces of a three-ply web to provide a web of more than three plies. This further layer or layers may be added alternately on opposite faces of the three-ply web.

The present invention also consists in apparatus for making a multi-ply web of paper or paper board or similar fibrous product comprising a travelling permeable carrier band whereon a base layer of watery pulp is formed, means for applying subsequent layers to opposite faces of said base layer, and means for dewatering each said subsequent layer from its exposed surface through a permeable member moving with said layer, whereby said layers are formed on said permeable member.



Preferably apparatus for manufacturing a three-ply web comprises co-operating permeable travelling carrier bands adapted to carry therebetween a formed base layer and a further formed or unformed layer on one face, guiding means to invert the bands, and means for delivering a layer of watery pulp to the opposite face of the web, thus providing a three-ply web.

Forms of apparatus for carrying out the methods of the present invention are illustrated in the accompanying drawings in which:

Fig. 1 shows an apparatus for making a four-ply web in which the subsequent layers are formed by upward dewatering of watery pulp.

Fig. 2 represents, to an enlarged scale, a cross section through a four-ply web made by the apparatus of Fig. 1.

Fig. 3 shows a modified apparatus for making a three-ply web in which two subsequent layers are dewatered through their exposed faces other than by upward dewatering.

Fig. 4 represents, to an enlarged scale, a cross section through a three-ply web made by the apparatus of Fig. 3.

Fig. 5 shows an alternative apparatus to that shown in Fig. 3 for making a three-ply web; by this apparatus the subsequent layers are both added beneath the base layer.

Fig. 6 illustrates diagrammatically modifications of the apparatus of Figs. 1, 3 and 5 for making webs with more than three plies and showing that the subsequent layers need not be added alternately.

Fig. 7 illustrates diagrammatically how a subsequent layer of pulp may be added both above and below a base layer in the same horizontal section, and

Fig. 8 illustrates how the invention may be applied on a single horizontal band.

The apparatus illustrated in Fig. 1 comprises an endless travelling carrier band 1 (the main band) directed into a series of four horizontal runs 1A, one below the other, and vertical runs 1B. The band 1 starts from a breast roll 2 and is diverted around a plurality of guide rollers 3 to provide the horizontal and vertical runs and finally returns to the breast roll 2, as indicated by chain line 1C.

A second permeable endless travelling carrier band 4 is also arranged so as to follow a substantially similar path to that of the band 1, but this second band only comes into operation at the first guide roller 3 above referred to where the first band starts its first vertical run 1B. Thus said second band 4 is trained around an upper guide roller 5 arranged above said first guide roller 3 in such a way that it provides a similar vertical run 4B substantially parallel to the first vertical run 1B of the first band 1. This second band 4 is then diverted around another guide roller 3 to provide a horizontal run 4A corresponding with the second horizontal run 1A of the first band 1 and so on and it finally returns to the upper roller 5 as indicated by chain-dot line 4C.

As will be seen the first section comprises the horizontal run 1A of band 1 alone, but the other sections comprise three vertical runs and three horizontal runs in which the two bands 1 and 4 run together for the most part in substantially parallel relationship.

Portions of the band 1 in the second and fourth horizontal runs 1A thereof and a portion of the second horizontal run 4A of the band 4 are trained around rollers 6 so as to lift the band through substantially rectangular paths clear of the lower band and then back to it again. The last roller 6 that diverts the run into the horizontal

again is, however, situated a short distance above the lower band so as to direct the upper bands towards the lower at an angle and thus provide a gap **7** between the bands. The gap **7** constitutes an entry to a wedge-shaped throat **8** that terminates where a fixed slice **9** presses the upper band firmly against the lower one.

In each of the spaces **10** defined by the rectangular path of the upper band—in two cases band **1** and in one case band **4**—there is located a flow box **11** for delivering pulp to the lower band.

A base layer flow box **12** is also situated above the breast roll **2**.

The three fixed slices **9** hereinbefore referred to comprise waterways sloping upwardly and forwardly to a gutter **13**, the arrangement being such that water from the pulp, due to its momentum, passes up the slices **9** to the gutters **13** and is hence removed.

The apparatus works in the following manner:

The first endless band **1** is set in motion by a suitable electric motor and this frictionally drives the second band **4**. A supply of pulp is fed to the flow boxes **11** and **12** so that it is delivered to the four horizontal runs **1A**, **4A**, **1A** and **4A** respectively.

A layer of pulp starts to form on the first horizontal run **1A** due to water passing downwardly through the band. This formed layer **14** (hereinbefore referred to as the "base layer") is carried around the first guide roller **3** where the second band **4** comes into operation.

The two bands **1**, **4**, with the formed base layer **14** sandwiched between, then pass into the second horizontal section where the first band **1** is guided clear of run **4A** of the second band **4** by means of the rollers **6** and a second layer of pulp **15** (the first of the "subsequent" layers hereinbefore referred to) is delivered onto the formed base layer **14**. The formed base layer **14** with superimposed watery pulp **15** then passes through the gap **7** into the wedge shaped throat **8** where the slice **9** nips the two bands **1** and **4** together and separates water from the second layer **15** of pulp. The majority of the water **16**, due to its momentum, flows through the first band **1** up the slice **9** into the gutter **13** whence it passes to a drain, but a small portion is absorbed by the underlying base layer **14**, the layer of pulp **15** thus becomes a formed web **17**. The first band **1**, which at this position (i.e. in the second horizontal section) is the upper band, constitutes a permeable member moving with the pulp layers through which the second layer of pulp **15** is dewatered from its exposed surface. It is to be understood that the expression "exposed surface" means the surface not in contact with another layer, in this case the formed base layer **14**.

The two integrated formed layers **14**, **17** are then inverted as they pass into the third horizontal section (where the second band **4** becomes the upper one and is guided clear of run **1A** of band **1**), the underlying or base layer **14** there becoming the upper layer. A third layer of pulp **18** is then delivered onto the upper exposed face of the inverted base layer **14** and this is dewatered in a similar manner to provide a formed web **19**. It will be appreciated that in this case the second band **4** constitutes the permeable member moving with the layers **14**, **17** and pulp layer **18**, and through which said pulp layer **18** is dewatered from its exposed surface to provide the upper layer of a formed three-ply web.

The three integrated formed layers **14**, **17**, **19** may then be inverted and pass, as shown, into the fourth horizontal section where a fourth layer **20** of watery pulp is added and dewatered in a similar manner; this fourth layer provides the uppermost layer **21** of an integrated four-ply web, indicated as leaving the dewatering apparatus at *x*, whence it passes to the usual wet presses, drying rollers and other known devices, to complete the manufacture of the board.

It will be observed that in the apparatus described with regard to Fig. 1 the added layers are dewatered during



their passage through the horizontal sections, thus it is as formed layers they are inverted.

Fig. 2 is a cross section through a web made on the machine shown in Fig. 1, and from this it will be observed that the first layer **14** has its long fibres **22** at the top, the second layer **17** has its long fibres **23** at the top, the third layer **20** has its long fibres **24** at the bottom, and the fourth layer **21** has its long fibres **25** at the top.

In a similar manner the above machine can be adapted for making a web having any reasonable number of plies. Thus in a fifth horizontal section, a fifth layer could be added and dewatered in a similar manner but this fifth layer is added on top of the third layer **20**, while in a sixth horizontal section (the web having been again inverted), a sixth layer would be added on top of the fourth layer and so on.

It will be appreciated that as each layer is dewatered directly from its exposed surface through the adjacent wire band, then each exposed surface of a completed web will be a "wire" face, in other words, long fibres will be distributed predominantly at said exposed surfaces.

The nipping effect of the fixed slices **9** on the watery pulp also helps to orient the fibres more evenly throughout the web, i.e. the fibres in a completed web are found to be more evenly oriented or dispersed both laterally and longitudinally.

Any or all of the rollers **3** that guide the bands may be provided with suction boxes **5A** to assist in the removal of water.

Figure 3 shows a modification of the machine illustrated in Fig. 1 but shows only a three-ply machine. The general layout of the machine is the same as that described with reference to Fig. 1.

Thus a layer **26** of watery pulp from a flow box **27**, is dewatered by a suction box **28** to become a base layer **29**. This base layer **29** is then inverted as it passes into the second horizontal section, where it is sandwiched between the bands **30** and **31**. A second layer **32** of watery pulp is delivered from flow box **27A** to the said base layer **29**.

Instead however of dewatering this layer **32** upwardly, as in the previously described embodiment, a suction box **33** is arranged adjacent the exposed face of the layer **32** to draw water through the band **30**. An alternative or additional position for this suction box is shown in dotted lines and numbered **33A**.

The base layer **29** and superimposed unformed layer **32** are inverted and pass into the third horizontal section where a layer of watery pulp **34** is delivered from flow box **27B** to the opposite face of the base layer **29** and this is dewatered by a suction box **35** in the vertical run **36** or by a box similar to the box **33A**, but in the next run, if a fourth layer is added.

The suction boxes may be omitted and dewatering effected by natural drainage through the permeable member adjacent the exposed face of the web.

It will be observed that the added layers in accordance with Fig. 3 are dewatered after they have passed out of the horizontal run on which they are delivered, thus the base layer and unformed layer are inverted when the latter is in an unformed state.

Fig. 4 shows a cross section through a web made in the apparatus of Fig. 3. It is shown as it would appear in the fourth horizontal run before a fourth layer of watery pulp has been added. Thus, as shown, it will be seen that the base layer **29** has its long fibres **37** at the bottom, the second layer **32** has its long fibres **38** at the bottom and the third layer **34** has its long fibres **39** at the top.

Fig. 5 shows a further modification in which layers are added beneath the previously formed layers.

In this figure, which again shows a machine for making a three-ply web, three endless wire bands **40**, **41**, **42**, are arranged one below the other with the lower run **40B** of the band **40** co-operating with the upper run **41A** of

the band 41, and the lower run 41B of the band 41 co-operating with the upper run 42A of the band 42. This provides three horizontal sections, of which the second and third each comprise upper and lower runs in parallel disposition. A flow box 43 is provided to deliver watery pulp for the base layer onto run 40A and flow boxes 44, 45 are provided, one for each of the upper runs 41A and 42A respectively. A doctor 46 is arranged for peeling a layer from the lower run 40B of the band 40 and doctors 47, 47A similarly are adapted to peel layers from the lower run 41B of the band 41 and the upper run 42A of the band 42.

In operation pulp is supplied to the pulp box 43, and the band 40 is set in operation by an electric motor, the band 40 acting frictionally to drive the bands 41 and 42. Pulp 48 from the box 43 is delivered to the upper run 40A and forms into a base layer 49, water passing to a tray 50. This base layer 49 is inverted as it passes around roller 51 into the next horizontal section.

At the entrance to this section, i.e. the right-hand end, a layer of pulp 52 is delivered beneath the base layer 49 onto the upper run 41A of the band 41 and this is dewatered downwardly during the passage between runs 40B and 41A, to provide a formed layer 53, the tray 54 acting to collect the water. The doctor 46 peels the double integrated formed layer 49, 53, from the lower run 40B of the band 40 and guides it around the roller 55 so that it is inverted as it passes into the third horizontal section where the flow box 45 supplies a layer of watery pulp 56 beneath the already formed layers, that is to say on the opposite face of the base layer 49, whereupon this layer 56 is dewatered downwardly during its passage between runs 41B and 42A to provide a formed layer 57, the water passing to a tray 58. In this apparatus, as in Fig. 1, the added layers are formed before being inverted as they pass into a lower run.

A three-ply web 59 thus issues from between the rollers 60, 61, being peeled from the runs 41B and 42A by the doctors 47, 47A respectively. The product of the machine described with regard to Fig. 5 is the same as that shown in Fig. 4.

In all the embodiments so far described the layers of watery pulp have been added to the base layer alternately on opposite sides thereof, but it will be understood that the apparatus can readily be modified to add further layers, but not alternately. For example, two layers may be added in succession on one face followed by two layers in succession on the other face. Thus, with the apparatus described with reference to Fig. 1, it is only necessary to make the second, third and fourth runs longer and raise the upper band clear of the lower band twice in each run, thus adding two layers in succession on each run.

In the modification shown in Fig. 3, a layer can be added on the second run by lifting the upper band 30 clear of the band 31 and introducing another layer of pulp which is dewatered upwardly.

Similarly in Fig. 5 instead of providing the flow box at the right-hand end of the run 41A, the lower run of the band 40 can be lifted clear of the band 41 and one or more layers of pulp may be added on the top surface of the base layer 49.

These three modifications are illustrated in Fig. 6 which is diagrammatic only. In this figure, F indicates flow boxes for delivering watery pulp, but the travelling permeable bands, the slices to provide for upwards dewatering and the suction boxes to provide for downwards dewatering are not shown. It is to be understood however that suction boxes may be dispensed with and downwards dewatering effected by natural drainage alone.

In this figure, A is the base layer (shown as a continuous line) the dotted lines B indicate layers of pulp applied in succession on one side of the base layer A, the chain lines C indicate layers added in succession on the opposite side of the base layer A, and, by way of example, the chain line D indicates a further layer.



Fig. 7 diagrammatically indicates how a layer of pulp may be delivered onto and beneath a base layer in the same horizontal section.

In this figure, as in Fig. 6, the base layer A is indicated by a continuous line, while added layers are indicated by dotted lines B on one face and by chain dotted lines C on the other face. F are flow boxes for delivering the pulp while the carrier bands and dewatering mechanism are omitted.

Fig. 8 diagrammatically indicates how layers of pulp may be delivered onto and beneath a base layer when the latter is carried by a single horizontal permeable travelling carrier band. In this figure again the base layer A is indicated by a continuous line and the added layers by dotted lines B at one surface, and chain dotted lines C at the other. F are flow boxes for delivering the various layers.

Other combinations for adding further layers to the base layer will be apparent from an examination of Figs. 6 to 8.

In all the arrangements however, subsequent layers added on opposite faces of the base layer are dewatered from their exposed surfaces, i.e. the surfaces not in contact with another layer.

I claim:

1. A method of making fibrous web material which comprises depositing fibrous stock on a travelling forming wire, draining water from the stock to form a base web on said wire, covering said base web with a second wire, separating the first wire from the web, introducing watery pulp on top of the wire side of the web, covering the watery pulp with said first wire, and dewatering the watery pulp through said first wire to form a ply of fibrous web material on the wire side of the first formed web.

2. A method of making multi-ply fibrous web material which comprises forming a fibrous web on the top run of a looped forming wire, covering the non-wire side of the web with a second looped forming wire, temporarily separating the first forming wire from the wire side of the web, introducing watery pulp on top of the wire side of said web, covering the watery pulp with the first forming wire, and dewatering the watery pulp through said first forming wire to form a second web on the wire side of the first web in integrated relation therewith.

3. A method of making multi-ply fibrous web material which comprises forming a base web on a first forming wire, covering the web on the first forming wire with a second forming wire, temporarily separating the first forming wire from the wire side of the base web, depositing watery stock onto the wire side of the first web after the first wire has been separated therefrom, covering the watery pulp with said first wire, dewatering the watery pulp through the first wire to form a ply of fibrous web material on the wire of the first web, temporarily separating the second wire from the non-wire side of the first web, depositing watery stock on the non-wire side of the first web after said second wire has been separated therefrom, covering the thus deposited watery pulp with the second wire, dewatering the watery pulp on the non-wire side of the first web outwardly through the second wire to form a fibrous web on the non-wire side of the base web, and pressing the two wires together to integrate the plies on the base web.

4. A method of making multi-ply fibrous web material having integrated plies which comprises depositing a layer of pulp on the top run of a first forming wire, draining water from the pulp through said top run to form a first web on the first wire, covering the non-wire side of the first web with a second forming wire, successively depositing watery pulp on opposite faces

of the first web while said first web is between said first and second forming wires, and dewatering the watery pulp outwardly from the faces of the first web through said first and second forming wires until the watery pulp forms into fibrous web plies integrated with the opposite faces of the first web.

5. A method of making multi-ply paper which comprises directing a main looped forming wire into a series of superimposed substantially horizontal runs, directing a second looped forming wire to cover at least some of the runs of said first wire, forming a base web on the first run of the first wire, successively separating the first and second wires from opposite faces of said base web, introducing watery pulp onto the opposite faces of the base web when the wires are separated therefrom, recombining the wires, and forming webs on the opposite faces of the base web by draining sufficient water from the watery pulp outwardly through the recombined wires away from the base web.

6. A method of making multi-ply fibrous web material which comprises forming a base web on the top run of a first looped forming wire, conveying the base web around a bottom run of said first looped forming wire, covering the non-wire side of the base web on the bottom run of said first wire with the top run of a second wire, introducing watery pulp on to the top run of said second wire against the non-wire side of the first web, dewatering said watery pulp through the top run of said second wire to form a ply on said non-wire side of the base web, transferring the base web with the ply thereon to the underrun of said second wire and thereby exposing the wire side of said base web, covering the wire side of said base web with the top run of a third forming wire, introducing watery pulp on to the top run of the third forming wire against the wire side of the base web, draining the watery pulp through the top run of the third wire, and forming a ply on the wire side of the base web.

7. A method of forming multi-ply fibrous web material which comprises forming a base web, successively depositing a plurality of layers of watery pulp on one face of the base web to form a plurality of plies of fibrous web material on said one face, thereafter successively depositing a plurality of layers of watery pulp on the opposite face of the base web, covering each layer of watery pulp with forming wire means, and forming webs from the fibers in each layer by dewatering through the covering wire means sufficient water from the watery pulp layer away from the base web to thereby form integrated plies on each face of the base web.

8. An apparatus for making multi-ply paper which comprises a main forming wire having a plurality of superimposed horizontal runs, a covering forming wire having a plurality of horizontal runs co-acting with the horizontal runs of the main wire, means for feeding a watery pulp layer to the first horizontal run of the main wire to form a base layer of stock thereon, means for separating the first wire from the wire side of said base layer of stock, means for introducing watery pulp between the separated wire and the wire side of the layer of stock, means for draining the watery pulp through the first wire to form a first ply on the wire side of said layer, means for separating the second wire from the non-wire side of the first layer, means for depositing the watery pulp between the separated second wire and the non-wire side of the first layer, means for draining the second watery pulp deposit outwardly through the second wire to form a ply on the non-wire side of the first layer, and means for bringing the wires together to unite the plies and form a unitary web.

9. A paper machine which comprises a plurality of superimposed looped forming wires each having a top forming run and a bottom carrying run, means for forming a base web on the top run of the top forming wire, means for introducing watery pulp between the top runs of the successive forming wires and webs carried on the bottom runs of the preceding forming wires, and means for draining the stock through the top run of each of said wires to drain the successively applied watery pulp outwardly from the base web and form plies on opposite sides of the web base.

10. A method of manufacturing multi-ply fibrous web material which comprises forming fibrous web stock into a base web, depositing layers of watery fibrous pulp on opposite faces of said base web, covering the layers of watery pulp with forming wire means, commingling the fibers of the watery pulp with fibers in the base web to form an integral mat, and forming webs on the opposite faces of the base web by dewatering through the covering wire means sufficient water from the watery pulp layers away from the base web to thereby provide a multi-ply web with integrated plies.

11. A method of making multi-ply fibrous web material which comprises forming a base web, depositing a first watery layer of pulp on one face of the base web, covering said first layer with a forming wire, draining said first layer through the forming wire cover therefor outwardly from said one face to form a first ply on said one face, depositing a second layer of watery pulp on the opposite face of the base web, covering said second layer with a forming wire, draining said second layer through the forming wire cover therefor outwardly from the base web to form a second ply on the said opposite face, and repeating said formation of plies on the respective opposite faces of the base web to build up the multi-ply web.

12. An apparatus for making multi-ply material which comprises a looped main forming wire, means for directing said main forming wire to provide a plurality of horizontal runs in superimposed relation, a second looped forming wire, means for directing said second looped forming wire to lap at least some of the horizontal runs of the main forming wire, means for separating a lapping wire run of one wire away from a web carried on the other wire, means for recombining the separated wires in lapped relation, and means for feeding watery pulp between the separated wires and the web.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 838,686 | Case | Dec. 18, 1906 |
| 997,011 | Scanlan | July 4, 1911 |
| 1,539,542 | Carmichael | May 26, 1925 |
| 2,108,231 | Nash | Feb. 15, 1938 |
| 2,730,933 | Reynolds | Jan. 17, 1956 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 505,140 | Great Britain | May 5, 1939 |