United States Patent [19]

Tokuno

[11] **3,923,595**

[45] **Dec. 2, 1975**

[54] **HIGH SPEED MULTI-CYLINDER MACHINE FOR MANUFACTURING A MULTI-PLY PAPER**

[75] Inventor: **Masateru Tokuno,** Nishinomiya, Japan

[73] Assignee: **Shizuoka-Kogyo Co., Ltd.,** Japan

[22] Filed: **Apr. 19, 1974**

[21] Appl. No.: **462,260**

Related U.S. Application Data

[63] Continuation of Ser. No. 74,302, Sept. 22, 1970, abandoned.

[52] **U.S. Cl.** **162/300;** 162/304; 162/318; 162/364

[51] **Int. Cl.²** **D21F 1/60;** D21F 11/08

[58] **Field of Search** ..... 162/300, 301, 303, 304, 162/318, 133, 363, 364, 368, DIG. 7, 306, 203

[56] **References Cited**

UNITED STATES PATENTS

3,201,305	8/1965	Webster	162/318 X
3,565,757	2/1971	Jordansson	162/317 X
3,671,388	6/1972	Nykopp	162/318 X

FOREIGN PATENTS OR APPLICATIONS

850,364	9/1970	Canada	162/300
45-14128	5/1970	Japan	162/303
37-5805	6/1962	Japan	162/318

Primary Examiner—S. Leon Bashore
Assistant Examiner—Richard V. Fisher
Attorney, Agent, or Firm—Brugess Ryan and Wayne

[57] **ABSTRACT**

A high speed, multi-cylinder arrangement for manufacturing multi-ply paper includes units each having a wire cylinder encircled in part by an endless wire screen which, in turn, is encircled in part by an endless felt. Stock is supplied onto the endless wire screen and into a sheet forming zone between the wire screen and the felt. A suction slider is located adjacent the location of the separation of the wire screen from the wire cylinder. Downstream of the suction slider, a suction box is provided for holding paper to the felt as the felt and wire screen are separated.

4 Claims, 4 Drawing Figures

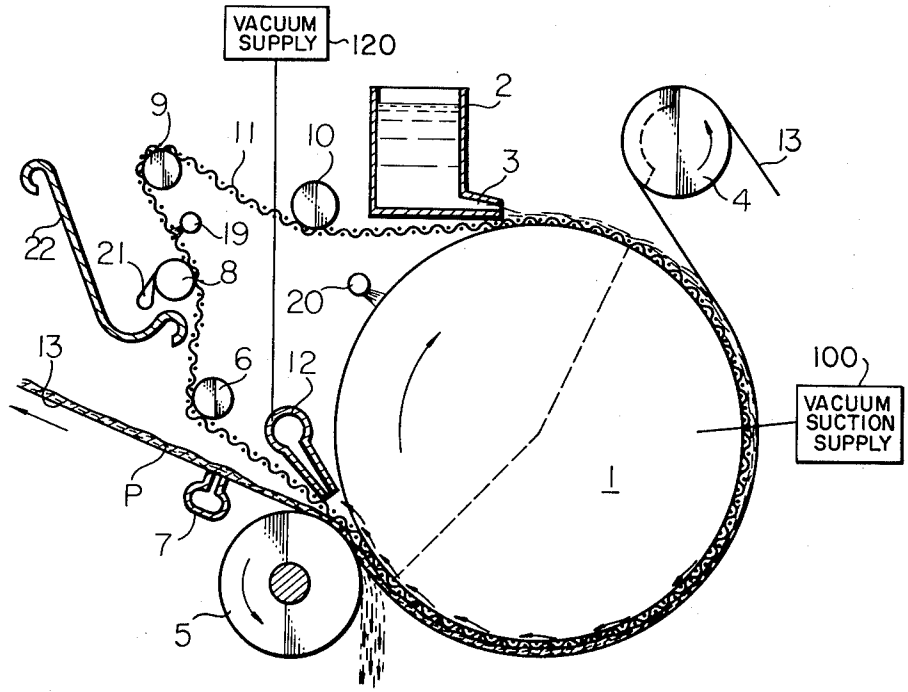


Fig. 1

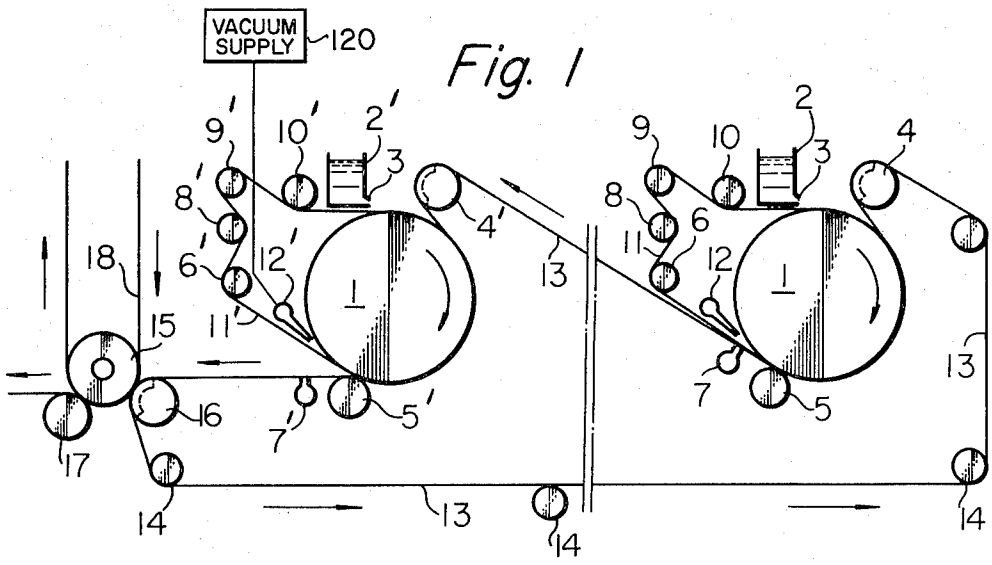

VACUUM SUPPLY
120
9'
10'
2'
3
8'
6'
12'
4'
13
18
15
11'
1
16
7'
5'
17
14
13
14
9
10
2
3
4
8
6
11
12
1
13
7
5
14

Fig. 2

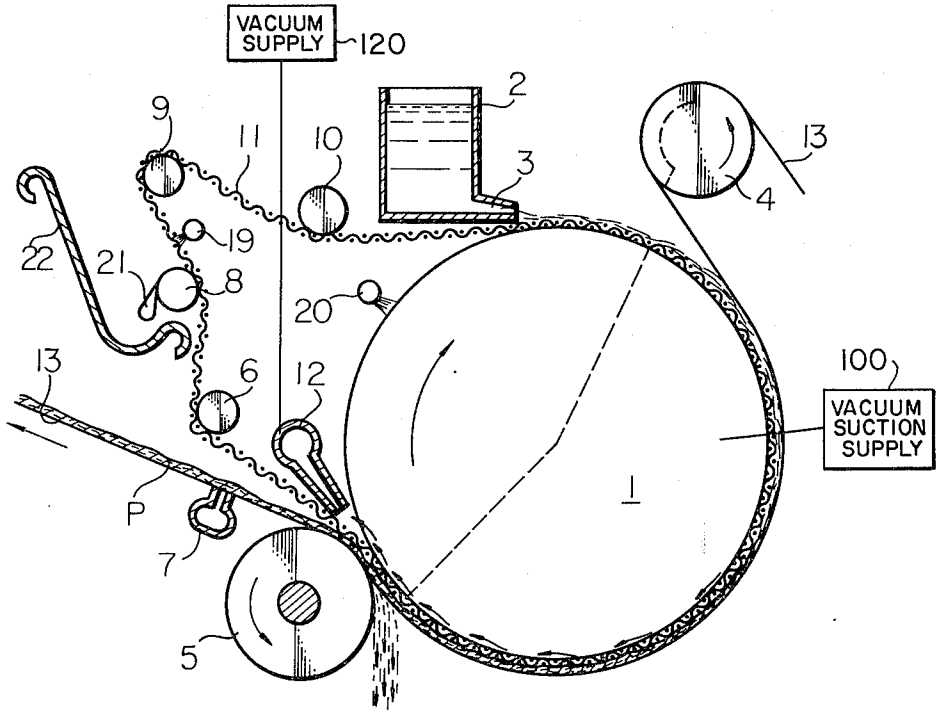
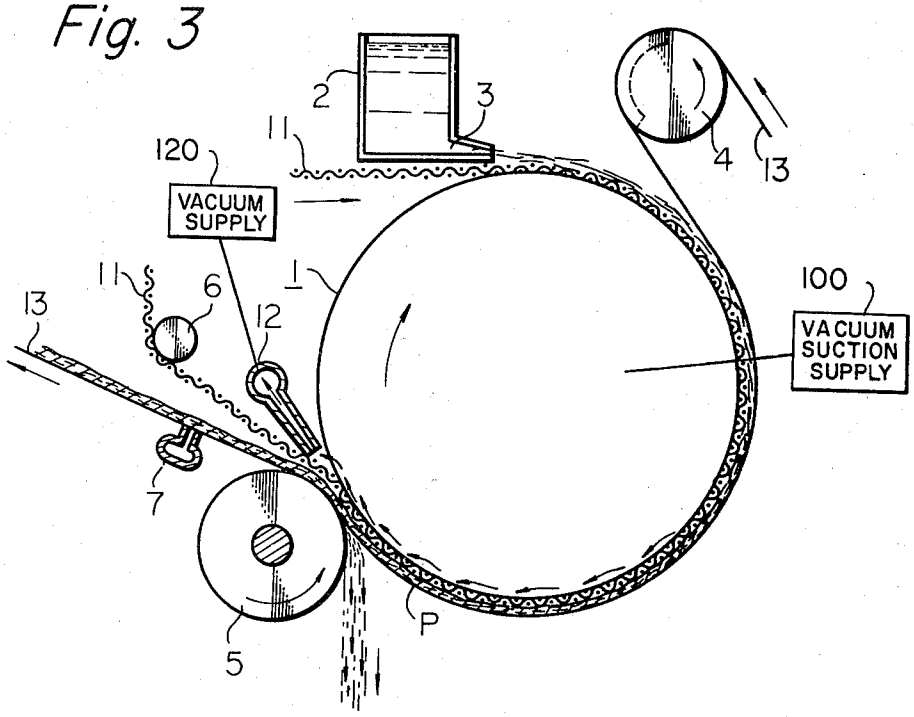

VACUUM SUPPLY
120
9
11
10
2
3
13
4
22
21
19
8
20
13
6
12
100
VACUUM SUCTION SUPPLY
P
7
1
5

Fig. 3


2
3
11
120
VACUUM SUPPLY
4
13
11
6
1
100
VACUUM SUCTION SUPPLY
13
12
7
P
5

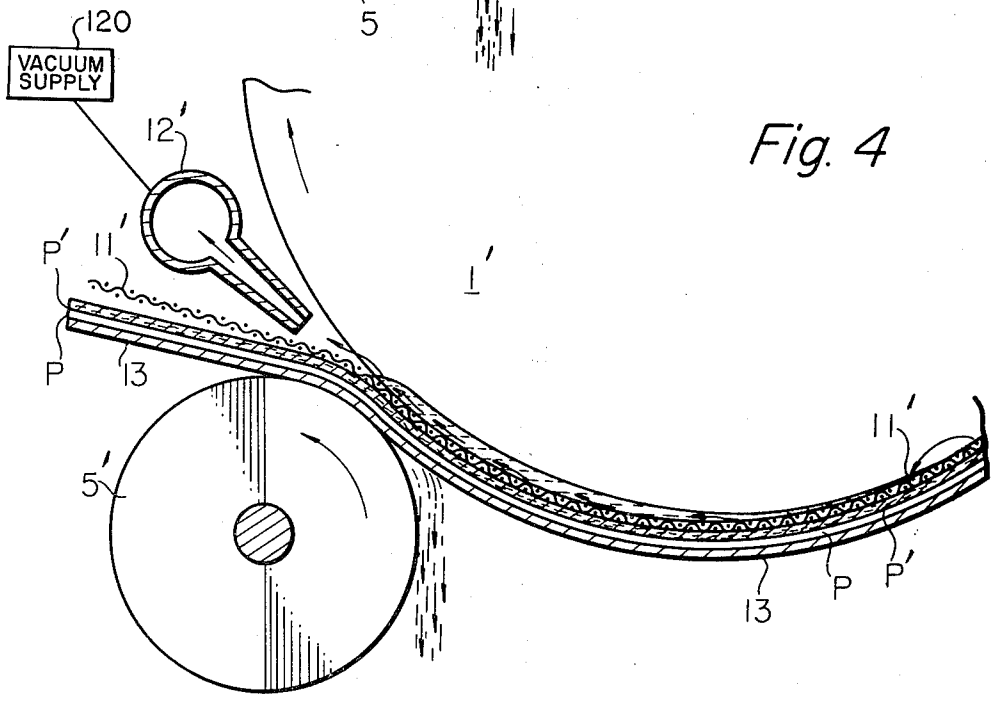

120
VACUUM SUPPLY
12'
P'
11'
1'
P
13
5'
11'
13
P
P'

Fig. 4

HIGH SPEED MULTI-CYLINDER MACHINE FOR MANUFACTURING A MULTI-PLY PAPER

This is a continuation of application Ser. No. 74,302, filed Sept. 22, 1970, now abandoned.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to an improved high speed multi-cylinder machine for manufacturing a multi-ply paper.

Generally, in the case of using a high speed multi-cylinder machine wherein each cylinder part is provided with a wire screen arranged above a felt and the wire screen forms a comparatively short passage so that forming of sheet is carried out upon the wire screen, it is inevitable that water content of the sheet is lowered so that clinging of fibers between sheets is weakened, that is, clinging force between sheets is weakened.

On the other hand, in the case of using a multi-cylinder machine wherein each cylinder part comprises a wire cylinder and a flow box disposed above the wire cylinder in such a way that a bottom aperture thereof faces the wire cylinder and an endless felt or wire screen encircles a part of the wire cylinder's bottom portion by way of a guide roller and a couch roll so that stock is fed into a space between the wire cylinder and the felt or wire screen and a continuous sheet formed during carrying with the wire cylinder and the felt or wire screen is picked off from the felt at a position of the couch roll, since accumulated water in the wire cylinder is ejected toward the wet sheet by the action of centrifugal force, the structure of the wet sheet may be damaged.

The principal object of the present invention is to provide an improved high speed multi-cylinder machine for manufacturing a multi-ply paper, which solves the above-mentioned troubles.

In each cylinder part of the high speed multi-cylinder machine according to the present invention, a wire cylinder is partly encircled by an endless wire screen by way of a pair of guide or wire rollers, a flow box is disposed above an upper horizontal passage of the wire sheet in such a way that a bottom aperture thereof closely faces the upper horizontal passage of the wire screen. A feed roller is disposed above the wire cylinder with a preferable distance from the bottom aperture of the flow box. A couch roller is disposed closely below the wire screen at an adjacent position of an outgoing nip between the wire cylinder and the wire sheet in such a way that the couch roll presses against the wire cylinder. An endless felt is guided by the feed roller and the couch roll so that the felt closely encircles the contact position of the wire screen with the wire cylinder. Consequently, stock is successively deposited on the wire screen at its horizontal passage and carried to the ingoing nip between the wire screen and the felt while forming a sheet, and then the sheet containing water is sandwiched with pressure by the felt and the wire screen while being carried from the above-mentioned ingoing nip and outgoing nip between the felt and the wire screen which coincides with a working position of the couch roll. A suction slider is closely disposed above the wire screen at the outgoing nip. In accordance with the above-mentioned carrying motion of the sheet, the water is extracted from the sheet at the above-mentioned outgoing nip by the couch roller and the suction slider. Further, the sheet is carried with the felt by applying suction force by the suction box. A plurality of cylinder parts having the above-mentioned members are successively arranged by way of utilizing a common endless felt. Therefore, a multi-ply paper made of stock supplied from the flow boxes can be made at a high speed with desirable clinging between sheets from a plurality of stock and with uniform density of fibers. In other words, a multi-ply paper having an excellent quality can be produced.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. **1** is a schematic diagram of a multi-cylinder machine, partly omitted, according to the present invention,

FIG. **2** is a schematic side view of each unit of the cylinder part, of the machine shown in FIG. **1**,

FIG. **3** is a schematic side view of a first cylinder part of the machine shown in FIG. **1**,

FIG. **4** is an explanatory side view of mid and outgoing nips of a further cylinder part of the machine shown in FIG. **1**.

DETAILED DESCRIPTION

Referring to FIG. **1**, a multi-cylinder machine according to the present invention is provided with a plurality of cylinder parts, each part comprises a wire cylinder **1** and an endless wire screen **11**. The wire screen **11** partly encircles the wire cylinder **1** and is guided by a pair of wire or guide rollers **6** and **10**. Tension of the wire screen **11** is adjusted by a tension roller **9**. A clearer roller **8** is rotatably contacted with the outside surface of the wire screen **11** at an intervened position between the wire roller **6** and the tension roller **9**. An endless felt **13** is guided by a feed roller **4** and a guide roller **14** and also a couch roller **5** so that the contact portion of the wire cylinder **1** with the wire screen **11** is closely encircled by the felt **13** as shown in the drawing. The couch roll **5** is positioned at a position below the outgoing nip between the wire cylinder **1** and the wire screen **11** so that the portion of felt **13** which encircles the wire screen **11** and the wire roller **1** is defined. A passage of the wire screen **11** above the wire cylinder **1** is almost horizontal, and a flow box **2** is disposed above the horizontal portion of the wire screen **11** in such a way that a bottom aperture **3** of a flow box **2** adjacently faces the wire screen. It is preferable that the bottom aperture **3** faces the ingoing nip between the felt **13** and the wire screen **11** above the wire cylinder **1**. The wire cylinder **1** is driven with the wire screen **11** and the felt **13** toward a direction represented by an arrow by means of a driving means (not shown). A suction slider **12** supplied with suction power by vacuum supply **120** is disposed at an adjacent position to the outgoing nip between the wire cylinder **1** and the wire screen **11** and a suction box **7** is disposed below the felt **13** at an adjacent position to the outgoing nip between the felt **13** and the couch roll **5**. The position of the flow box **2** can be adjusted so as to change along the passage of the wire screen **11** while the position of the feed roller **4** can also be adjusted along a direction toward the bottom aperture **3** of the flow box **2** so that a space adjacent to the ingoing nip between the felt **13** and the wire screen **11** can be adjusted. In the above-mentioned embodiment of the present invention, the endless felt **13** is commonly used for each cylinder part so that a continuous sheet sandwiched by the felt **13** and the wire screen **11** is carried with them while these members encircle the wire cylinder **1**. At the outgoing nip, since a

suction aperture of the suction slider **12** closely faces the wire screen **11**, water contained in the sheet is sucked into the suction slider **12** while the sheet is carried with the felt **13** by a suction force of the suction box **7** when the sheet leaves the outgoing nip between the couch roller **5** and the wire cylinder **1**, preventing the sheet from being carried with the wire screen **11**. As already illustrated, the endless felt **13** is next driven to the feed roller **4** of the next cylinder part having the same construction as that of the previous one and finally driven to a pair of suction rollers **15** and **16**, so that water contained in the felt **13** is removed, and then the felt is returned to the feed roller **4** of the first cylinder part by way of a plurality of guide rollers **14**. The suction roller **15** is belted with a top felt **18**. A pair of shower nozzles **19** and **20** are disposed adjacently to the wire screen **19** and the wire cylinder **1** as shown in FIG. **2** and a doctor **21** is disposed so as to contact with the clearer roller **8** in order to remove waste from the roller **8** when waste is carried with the wire screen **11** and wound about the roller **8**. A saveall **22** is disposed below the clearer roller **8** to receive the waste removed from the clearer roller **8**.

When stock is continuously deposited upon the wire screen **11** from the flow box **2** while driving the wire screen **11** and the endless felt **13** at the same running speed, the stock flows freely toward the ingoing nip between the wire screen **11** and the endless felt **13** and a small quantity of water contained in the stock passes through the wire screen **11** so that the water adheres to the wire cylinder **1**. The stock fed into a space between the wire screen **11** and the endless felt **13** is pressed by pressure of the felt **13**, which is created by the driving tension thereof. Consequently, a continuous sheet of fibers (hereinafter referred to as a sheet) is formed while being carried with the wire screen **11** and the felt **13** which are running at the same speed. Water contained in the sheet partly passes through the wire screen **11** and enters the wire cylinder **1** while the sheet is being carried with the wire screen **11** and the felt **13**. However, the water entering into the wire cylinder **1** adheres to the inside surface thereof by action of centrifugal force created by a high speed rotation of the cylinder **1**. On the other hand, a part of the water contained in the sheet is absorbed into the felt **13**. By the above-mentioned operation, a wet paper-like sheet P is created. In other words, the stock supplied into the space between the wire screen **11** and the endless felt **13** is formed firstly into a continuous sheet and rapidly changed into a wet paper-like sheet P while being carried with the wire screen **11** and the felt **13**. At the outgoing nip of these members, the couch roller **5** presses the wet paper-like sheet P together with the wire screen **11** and the felt **13** towards the wire cylinder **1** so that water remaining in the sheet P is further squeezed and the squeezed water drops from the couch roller or enters into the wire cylinder **1** through the wire screen **11**. Water entering into the wire cylinder **1** is ejected outside of the cylinder **1** and sucked into the suction slider **12** when the sheet P is delivered from the outgoing nip and carried with the felt **13** in accordance with the suction force of the suction box **7**. To attain the above-mentioned suction effect of the suction slider **12**, the suction aperture thereof faces a tangential direction of the wire cylinder **1** with respect to the outgoing nip. After completion of the above-mentioned operation, the sheet P is carried to the following cylinder part together with the felt **13**.

Referring to FIG. **4** which illustrates a second cylinder part, continuous supply of stock upon the running wire screen is similarly carried out as in the first cylinder unit. For the convenience of illustration, members of the second cylinder part are "primed". In this embodiment, the supplied stock upon the second wire screen **11'** has a similar fiber density as that of stock prepared in the second flow box **2'**. Since the sheet P is carried from the first cylinder part and passes to the second cylinder part with the felt **13**, the stock supplied from the second flow box **2'** flows to an ingoing nip between the second wire screen **11'** and the sheet P and then a fresh sheet P' is formed between the second wire screen **11'** and the sheet P while being carried with the second wire screen **11'**, the sheet P and felt **13**. Since the fresh sheet P' contains water, a part of the water is squeezed from the fresh sheet P' while being carried with the second wire screen **11'** and the sheet P and the felt **13** so that the squeezed water passes the second wire screen **11'** and enters into the wire cylinder. On the other hand, a part of the water squeezed from the fresh sheet P' penetrates into the sheet P and the felt **13**. By the above-mentioned carrying operation of the fresh sheet P' with the sheet P, surface fibers of the fresh sheet P' cling to surface fibers of the sheet P so that these sheets P and P' are joined together as a continuous two-ply sheet. This two-ply sheet is delivered from the outgoing nip between the second wire screen **11'** and the felt **13** at the position where the second couch roller **5'** is rotatably urged to the wire cylinder **1'**. As already illustrated in the case of the first cylinder unit, water, which is squeezed from the fresh sheet P' and enters into the second wire cylinder **1'**, is ejected from the second wire cylinder **1'**, towards the suction aperture of the second suction slider **12**, and water, which penetrates into the sheet P and the felt **13**, is squeezed by the couch roller **5'**, while the two-ply sheet is carried with the felt **13** by aid of the suction force of the second suction box **7'**.

A plurality of the above-mentioned sheet forming operations can be repeated so that a multi-ply sheet is formed. And finally, water is further extracted from this multi-ply sheet when the multi-ply sheet passes through the nip between the top felt **18** and the suction roller **16**. Then, the sheet is carried to the nip between the top felt **18** and the press roller **17** so that the multi-ply sheet is carried to the following process. On the other hand, the felt **13** is carried to the feed roller **4** of the first cylinder unit by way of a plurality of guide rollers **14**.

In the above-mentioned process, the distance between the bottom aperture **3** of the flow box **2** and the feed rollers **4** may be adjusted or an entrance space before the ingoing nip between the felt **13** and the wire screen **11** may be also adjusted, in accordance with the fiber density of the stock.

In the case of driving the members of the cylinder parts at very high speed of more than 500 m/min the contact pressure between the wire cylinder **1** and the wire screen **11** together with the felt **13** tends to decrease because of centrifugal force thereof. To prevent the above-mentioned decrease of the contact pressure a vacuum suction means **100** may be connected with the interior of wire cylinder **1** as shown in FIG. **3**, or with that portion of the interior of the wire cylinder **1** indicated by the dashed line through cylinder **1** in FIG. **2**. Further, a suction roller may be used for the feed roller **4** to prevent separation of a sheet therefrom when

the sheet produced in the previous cylinder part is fed with the felt **13.** When parts of the sheet adhere to the wire screen **11** at the outgoing nip and are carried by the wire screen **11,** parts of the sheet are wound about the clearer roller **8** and removed from the clearer roller **8** by means of the doctor **21** so that the removed substance is dropped into the save-all. COnsequently, the wire screen **11** can always be maintained in a clean condition.

As already illustrated, in the multi-cylinder machine of the present invention, there are several characteristic features, that is, when the stock deposited upon the wire screen is carried to the ingoing pin above the wire cylinder **1,** since the distance between the bottom aperture **3** of the flow box **2** and the ingoing nip is sufficient to distribute fibers in the stock uniformly along the wire screen **11,** the fibers in the stock are entangled with each other so that sheet having a strong configuration can be created. The stock fed into the ingoing nip contains a similar quantity of water to that of the stock because a very small quantity of water is only removed from the stock deposited upon the wire screen until the stock is carried to the ingoing nip. Therefore, formation of sheet is carried out uniformly at the zone of sheet formation between the ingoing and outgoing nips. Further, water removed from the sheet and entered into the wire cylinder **1** is sucked into the suction aperture of the suction slider **12** at the adjacent position of the outgoing nip so that it is prevented from damaging the sheet by the running water from the wire cylinder **1.** Since the sheet formation is carried out with pertinent pressure between the wire screen **11** and the felt **13** while containing water in the sheets at the process after the first cylinder part, binding of a fresh sheet with a sheet carried from a previous cylinder part is strongly attained even though the running speed of the members of each cylinder part is very high, more than 500 m/min.

What is claimed is:

1. High speed multi-cylinder arrangement for manufacturing multi-ply papers comprising a plurality of cylinder parts, each cylinder part comprising a wire cylinder having an upper section and a lower section and rotating at a high speed, an endless wire screen first making contact with said wire cylinder at said upper section and encircling a part of said wire cylinder and separating from contact with said wire cylinder at said lower section, an endless felt encircling said endless wire screen at said part of said wire cylinder so that said endless wire screen and said felt form a sheet forming zone therebetween, said wire screen and felt moving at the same running speed as said wire cylinder, tension means for contacting said wire screen with said wire cylinder under pressure, means for guiding said felt so that part of said wire cylinder is encircled with said felt and said felt is urged toward said wire screen under pressure, a flow box disposed above said wire screen and provided with a bottom aperture to deposit stock upon said wire screen, said flow box being located above said wire screen at a predetermined distance from an ingoing nip of said sheet forming zone, said wire screen being carried along a horizontal passage between a position below said flow box and said ingoing nip, a couch roller disposed below said wire cylinder, said couch roller being urged toward said wire cylinder to press said felt and wire screen against said wire cylinder, first and second roll means spaced from said couch roller, said screen extending from said lower section of said wire cylinder around said first roll means whereby said first roll means determines the location of separation of said screen from said wire cylinder, said felt extending from said sheet forming zone at said couch roller to said second roll means whereby said second roll means determines a location of separation of said felt and screen at said couch roller, a suction slider located adjacent said lower section of said wire cylinder between a surface of said wire cylinder and said wire screen adjacent said location of separation of said screen from said wire/cylinder, said suction slider having a suction aperture facing in the tangential direction of said wire cylinder at said location of separation of said screen from said wire cylinder to draw water from within said wire cylinder, means connected to said suction slider for applying suction thereto, and a suction box disposed adjacent said couch roller downstream of said location of separation of said felt from said screen, said suction box located below said felt and below said wire screen closely downstream of said suction slider, said suction box provided with a suction aperture closely facing the underside of said felt for holding paper formed between said felt and wire screen to said felt at said location of separation of said felt from said screen.

2. High speed multi-cylinder arrangement according to claim **1,** further comprising a clearer roller contacting said wire screen at a position above said suction slider, said clearer roller provided with a doctor in continuous contact therewith, and a save-all disposed below said clearer roller to receive waste removed from said clearer roller.

3. High speed multi-cylinder arrangement according to claim **1,** wherein said guide means of said felt comprises a feed roller disposed at said ingoing nip position.

4. High speed multi-cylinder according to claim **1,** wherein the interior of said wire cylinder is connected to a vacuum means.

* * * * *