

Dec. 5, 1961

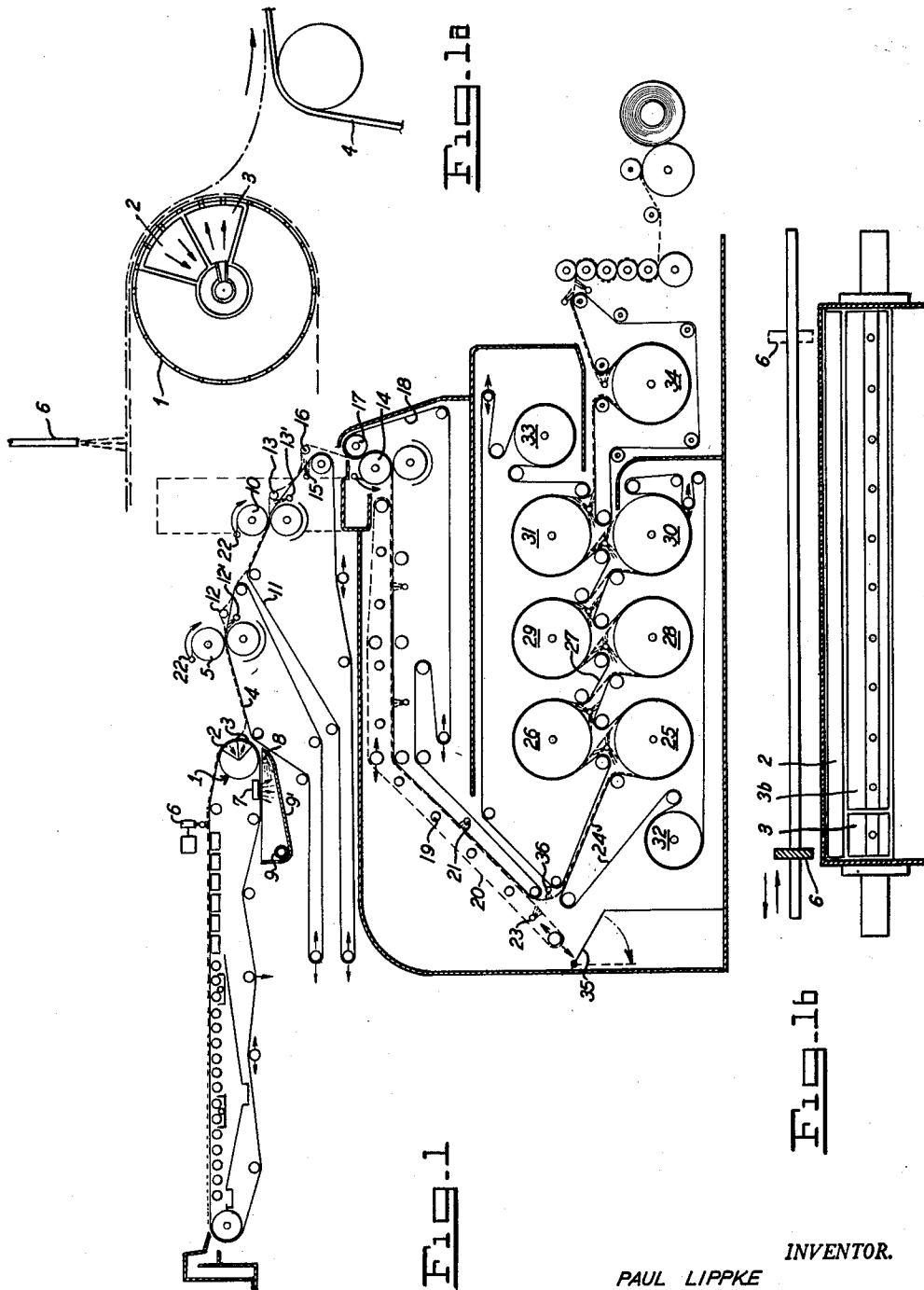
P. LIPPKE

3,011,544

MACHINES FOR THE MANUFACTURE OF WEBS OF FIBROUS MATERIAL

Filed Jan. 9, 1959

2 Sheets-Sheet 1



INVENTOR.
PAUL LIPPKE

BY

Burgess, Dicklage & Sprung

ATTORNEYS

Dec. 5, 1961

P. LIPPKE

3,011,544

MACHINES FOR THE MANUFACTURE OF WEBS OF FIBROUS MATERIAL

Filed Jan. 9, 1959

2 Sheets-Sheet 2

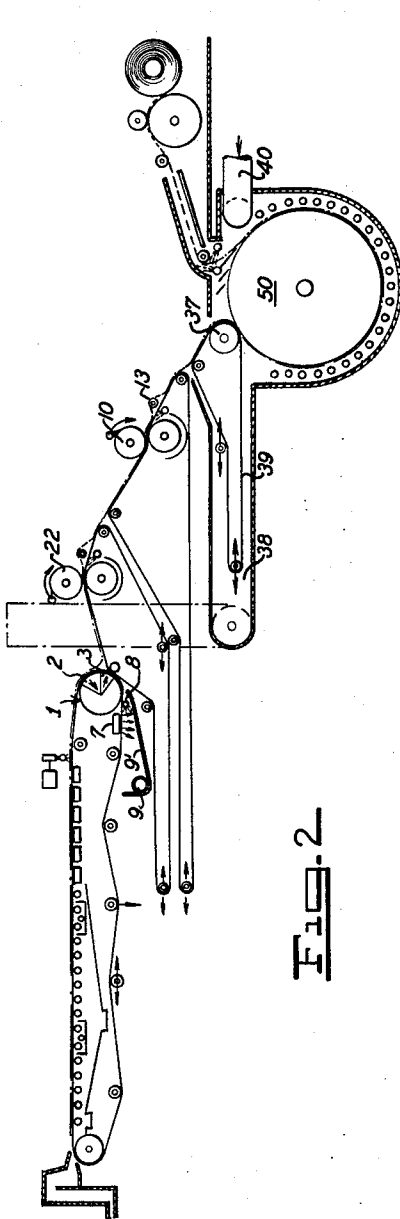


Fig. 2

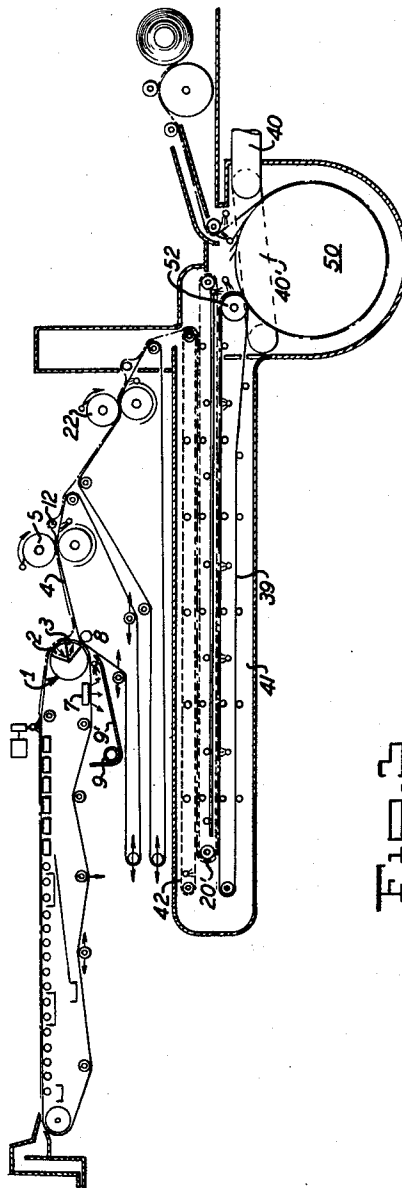


Fig. 3

INVENTOR.

PAUL LIPPKE

BY

Burgess Dick, Lloyd Spring

ATTORNEYS

1

2

3,011,544

MACHINES FOR THE MANUFACTURE OF WEBS OF FIBROUS MATERIAL**Paul Lippke, Augusta Strasse 17, Neuwied (Rhine), Germany****Filed Jan. 9, 1959, Ser. No. 818,991****8 Claims. (Cl. 162—289)**

The invention relates to machines for the manufacture of webs of fibrous material, for example of paper.

Known constructions of machines for manufacturing webs of indefinite length of fibrous materials, such as are used in the manufacture of cellulose, paper and cardboard, are little suited to the modern trend with respect to reducing the required amount of operating personnel, and centralizing the control of the machine, as well as an automatization of the operation. Also the costs for erecting these machines are comparatively high owing to the retention of the traditional arrangement of the individual machine elements relative to one another. Finally a good thermal operating efficiency for the removal of water from and drying of webs made on these machines can be achieved only with difficulty and expense.

Since for various purposes of use, that is to say no matter whether such machines are used in the cellulose, paper or cardboard industry, similar constructional elements and constructional forms are used, the machines embraced by the present invention will be simply called paper making machines.

By the present invention, disadvantages in the previous constructional forms of paper making machines which mitigate against a cheaper manufacture and a cheaper operation are at least in part removed.

The longitudinally extending constructional form of paper making machines which is usual at the present time requires a great amount of space, and renders the observation of the manufacturing process by operating personnel difficult, so that for operation a great number of persons are required, and it becomes difficult to obtain an automatization of the manufacturing process.

Moreover the previous constructional forms are costly. Extensive support has to be provided for the drier part with its heavy machine elements and it is necessary to perform the drying, starting from a last press, on expensive drying cylinders. A typical example of this unsuitable construction is given by the paper making machine with an automatic removal cylinder. While the sieve part and press part which is light in weight are provided in the lowermost level of the machine space, the large and heavy automatic removal cylinder is arranged high above the sieve part and the press part and rests of necessity on a strong supporting frame. The costs of the supporting frame for the automatic take up cylinder are high.

It is an object of the invention to provide an arrangement by which the high costs are considerably reduced, and the difficulties of erecting the machine, and the dimensions of the automatic removal cylinder are reduced.

According to present day possibilities, which research and experience offer in connection with the construction of paper making machines, the conventional arrangement of the press part is unsuitable. The moving forward of the wet web in such paper machines which comprise a so-called reversing press in a third pressing stage is difficult and requires an experienced operator for operation of the machine, and damage can easily occur to the wet paper web due to the over-high demands made as a result of the unavoidably high tensional stresses.

Furthermore the utilization of heat not used in the drier part, and its recovery, is capable of extremely great improvement. The present day arrangements for re-

covering a part of the waste heat of the drier part of a machine require a considerable space, and are expensive to operate, and are nevertheless insufficient with respect to their efficiency.

To these, other difficulties have to be added with respect to the operation of the machine and performance of the manufacturing process, which are determined by the present day constructional form of the paper machine and which it is an object of the present invention to at least in part to avoid.

The invention consists in a machine for the manufacture of webs of fibrous material, for example of paper, comprising a sieve part, a press part having a plurality of presses, and a drier part having an air drier and a cylinder drier, the sieve part being arranged in an upper plane of the entire machine and the drier part in a lower plane of the machine, the drier part wholly or partly extending underneath the sieve part and the press part.

Thus, the present invention utilizes a basic idea which has been used in connection with other continuously travelling manufacturing processes with considerable advantage.

As with other mass products the basic idea has been realized that the material to be produced should be moved in the course of the manufacturing process under its own weight and so in this manner pass all the stages in the manufacturing process. Similarly also the paper web should descend from a higher point, as far as possible without change of direction in a vertical direction, downwards and should move under the influence of its own weight through the different parts of the paper making machine until the web has been sufficiently predried so that without damage to the qualities gained on a sieve of the machine a change of direction which of necessity is always connected with tensional stresses, can be undertaken.

In an arrangement of the present invention on leaving the sieve part of the machine, the paper web is at the highest level of the entire machine and all the other parts following in the course of the manufacture are arranged in steps one below the other so that not only a faultless guiding of the paper web through the various operating regions is effected and the operation of the machine is facilitated, but also the paper web itself is carefully handled.

Therefore of necessity an arrangement results wherein the heavy machine elements of the drier part can be arranged underneath the sieve part and press part. Thereby a considerable reduction in cost of the machine itself is obtained especially in connection with automatic removal machines and combined machines for paper which is smooth at one side only, and simultaneously an essential saving of space and reduction in cost of a building surrounding the machine is achieved, since as is known a building having the same volume can be erected more cheaply if it has a smaller ground area.

By this basic arrangement of the sieve part and press part above the drier part not only better utilization of the waste heat which has not been used in the drier part is achieved but also simultaneously a considerable reduction in the dimensions of the drier surface is enabled, for which a contact drying on cylinders is necessary.

A simplified and improved utilization of the waste heat of the drier part is rendered possible by the feature that the felt of the last press preceding the drier part is conducted within an air channel through which waste air from the drier part flows. The paper web, lying on the felt of the last press, is guided for a considerable length to the drier part proper with drying cylinders. Thereby the felt and the web are heated and already pre-dried to a great extent.

The pre-drying of the paper web on the felt of the

last press is advantageous, since for a smooth condition of the paper it is sufficient if drying on cylinders of a single sided calender begins at a 55% dryness degree, and with paper machines for machine calendered paper it is even more advantageous to being drying on contact cylinders, with the use of drying felts, only after the compensation of the largest shrinking step, that is to say at about a 75% dryness degree.

It has been proposed to facilitate removal of water by presses in paper making machines, by heating the water in the paper web since the viscosity of the water is reduced and thereby the water can more easily emerge from the web and the felt at the nip of a press. In the arrangement of the present invention, the waste heat of the drier part is utilized for preheating the paper web and the felt or the felts of a press or presses whereby the dryness of the web can be increased so far that the overall thermal effect is much more favorable than the recovery of part of the waste heat of the drier part by means of heat exchangers heating incoming air at the drier part. Heat exchangers can nevertheless still be utilized subsequent to the herein described utilization of the heat of the waste air.

In order to make the invention clearly understood, reference will now be made to the accompanying drawings which are given by way of example and wherein:

FIG. 1 diagrammatically illustrates a paper making machine having a so-called open cylinder part, for the manufacture of machine smooth papers;

FIG. 1a shows in greater detail the positioning of the suction roller;

FIG. 1b shows in greater detail the positioning of the spray cutter; and

FIGS. 2 and 3 illustrate a similar arrangement but with automatic removal cylinders.

The machine of FIG. 1 in common with other paper making machines comprises a flow box and sieve part, a press part, a pre-drier and a cylinder part, and if desired a subsequent calender.

The manufacture of the fibrous web is effected in the usual manner, pulp flows through the flow box onto the sieve, where water is removed, and is finally fed to a suction roller 1.

The suction roller 1 differs from known constructional forms, in that it has two chambers, a suction chamber 2, and a compressed air chamber 3. The suction chamber 2 operates in the usual manner, whereas the compressed air chamber 3 is supplied with compressed air for blowing the web from the sieve onto a felt 4 of a first press 5.

As shown in FIGS. 1 and 2 the felt 4 of the first press 5 is conducted directly underneath the suction roller 1 so that of necessity the paper web is passed from the suction roller onto the felt 4. In the longitudinal direction of the suction rollers, the compressed air chamber 3 is subdivided into two compartments. One of the compartments faces the feeding side of the machine and has such a width as is sufficient for separately handling a tip of the paper web required for moving on of the web. The paper pulp which has passed the sieve part can not be conveniently transferred to felt 4 with the form or shape as defined by the foremost part of the web. It is an advantage to cut the same so as to impart to the lead part of the paper pulp web a shape or tip conducive to such transfer. When the paper web is subdivided by a spray cutter 6 for forming the tip, then that compartment of the compressed air chamber 3 which lies towards the leading side is supplied as before with compressed air and the tip is fed onto the felt 4. In this case the other larger, compartment of the compressed air chamber 3 is not supplied with compressed air and the paper web remains adhered to the sieve and is blown therefrom by air from a compressed air chamber 7 provided on top of the sieve, causing the web to drop into a shallow trough, which re-

places the hitherto usual waste trough. With the aid of a water spray pipe 8 the web in the trough is dissolved and fed to a tube 9 for further use.

When the tip of the paper web has been fed the spray cutter 6 is moved towards the driving side of the machine and the compartment of the compressed air chamber 3 lying at this side again receives compressed air so that the entire web is blown onto the felt 4 of the press 5, as shown in the FIG. 1b. A second press 10 of the machine is arranged somewhat below the first press 5. A felt 11 of this second press again is arranged in such a manner that the web is automatically taken over without any pull from the felt 4 of the first press 5. Lifting of the paper web over release rollers 12 and 13 is effected by blowers 12' and 13' correspondingly arranged below the respective release rollers, the air current of the blowers being sufficient for acting through the felt to blow the paper web over the rollers, which are relatively small.

The greatest damage to a paper web is caused in previous paper making machines usually at the entrance to a reversing press of the machine. Here the paper web has to be conducted upwards over two guide rollers, so that over a considerable length the web is unsupported. Besides due to tensional forces as a result of its own weight, the web is additionally subjected to tensional forces as a result of the frictional movement of the bearings of the two guide rollers. Additionally after leaving the press the web again has to be conducted in long unsupported paths over one or more guide rollers to the dry part of the machine. Since at this point the fibres of the web are not yet rigidly interlinked with each other the tensional forces considerably detract from the mechanical rigidity of the web.

Since however reversing presses are advisable from a viewpoint of good water removal action and uniformity of both surfaces of the paper web, a reversing press is provided in the machine of the invention. The reversing press 14 is arranged below a press 10 through which the web passes before reaching the reversing press 14. The reversing press 14, however, runs in a direction opposite to that of the presses 5 and 10.

The paper web is lifted by air from a blower tube 15, over a release roller 16 and after only a short unsupported drop reaches a felt guide roller 17 of the reversing press 14. From here the paper web is automatically introduced into the reversing press 14. Thus the side of the paper which hitherto faced the felt faces the surface of an upper roll of the reversing press. This arrangement is simple and avoids the above mentioned disadvantages of previous reversing presses. In particular it facilitates the operation of the machine and enables an automatization of the machine operation, whereas in prior machines the introduction of the paper web into a reversing press of known construction required great experience on the part of the operator.

As shown in FIG. 1, it is possible by this construction to use simply guided elongated felts for all the presses, in particular also for the first and second presses of the machine. The guiding of the felts is possible without a large number of reversing rollers which are subjected to frictional losses and impose a load on the felt. The felts of the presses 5 and 10 are conducted partly underneath the sieve part. Owing to the fact that they thus lie above a casing surrounding the drier part of the machine they are already heated by hot air rising from this casing.

A felt 18 of the last press extends within an air channel formed within the casing, through which the hot air which rises from the drier part flows.

This construction has a twofold purpose:

The felt 18 of the last press before the drier part is strongly pre-heated by the hot air from the drier part and is liberated from a part of the water contained therein. Thereby the felt 18 is rendered particularly receptive to water liberated from the paper web in the press 14.

At the same time the viscosity of the water remaining in the web is reduced so that the water emerges more easily from the nip of the press 14. Furthermore, the guide roller 17 for the felt 18 is positioned at a high point on the periphery of the upper roll of the press 14 so that the felt 18 has a large angle of contact. The press 14 itself is positioned in the hot air current from the drier part. The rolls of the press 14 are heated and likewise the felt, having a considerably greater weight per square meter, is heated so that an effective preheating of the paper web entering the press 14 is obtained before the pressing operation in the press 14 begins. Thereby the viscosity of the water in the paper web is reduced and the water can more easily leave the paper web. Thus a considerable improvement in the dryness degree of the paper web, that is to say in the water removal stage, is obtained in this press.

The paper web is carried by the felt 18 of the press 14 over a relatively long path. The surface of the paper web is subjected to the hot waste air current from the drier part; the current may be increased by the provision of fans, not shown, causing circulation of the waste air, the paper web being dried in a counter-current flow of air. In order to improve this drying still further, heating members 19 are provided above the paper web in the air channel. The heating members 19 may be hot air blowers or heat radiators, heated electrically or by gas. For protecting the paper web against the possibility of the drying air flowing through the air channel lifting it from the felt 18 a light metal sieve 20 is provided for holding the paper web onto the felt 18. The sieve 20 presses onto the paper web sufficiently by its own weight and is so constructed that steam liberated from the paper web can freely emerge therefrom.

In order to obtain ventilation of the paper web at the side facing the felt 18, hot air blowers 21 having a strong blowing action are provided underneath the felt 18, so that steam accumulating there can be easily removed.

In order to ensure an easy transition for the paper web running from the presses 5, 10 and 14 these presses are in known manner provided with movable doctors which are rotatable about the axis of the upper roller of each press. The rotation of these doctors may be effected automatically, in known manner. By rotating the doctors the paper web is in each case removed from the upper roller of the respective press and passed onto the felt for being transported further.

After the paper web has been dried to such an extent that it now can withstand tensional forces, a drying on cylinder driers commences. The cylinder driers, their felts and felt driers, are located in an enclosed casing, an upper part of which forms the above mentioned air channel in which the press 14, the felt 18 and the metal sieve 20 are located.

In the arrangement of the drier part care has been taken that as far as possible a self-acting moving on of the paper web takes place. As soon as the paper web has left the felt 18 it is blown by a blower 23 onto a lower drying felt 24, which takes over the paper web and guides it into a first lower drying cylinder 25. The paper web runs over a doctor 25' associated with this cylinder, the doctor being so constructed that it blows hot air in several directions. For this purpose a holder for the doctor is in the form of a tube which is provided with suitable air jets. One stream of air from the doctor holder blows the paper web into the nip between the felt 24 and the drying cylinder 25, as the paper web approaches the drying cylinder 25. A second stream of air blows the paper web away from the doctor and lifts it. A third stream of air moves the paper web, assisted by air from a doctor holder of a first upper cylinder 26 into the nip between the said first upper cylinder 26 and an upper drying felt 27. As the paper web leaves the drying cylinder 27 the same cycle of operation is repeated so that the paper web is blown by air from the doctor holder

of the cylinder 26 onto the lower drying felt 24. This now forms a channel together with a part of the upper drying felt 27, securely guiding the paper web to a next lower drying cylinder 28. The operation is then repeated for further drying cylinders 29, 30 and 31.

In order to supply sufficient fresh air to the drier part and also for the pre-drying of the paper web on the felt, and simultaneously for obtaining a good drying of the drying felts, guide rollers which are provided for conducting the drying felts for the drying cylinders 29 to 31 are constructed in known manner as perforated rollers through the periphery of which hot air is blown onto the felt. In this manner sufficient dry air is rendered available for carrying away steam emerging from the paper web and for drying the paper web. The hot air which emerges from the doctor holders likewise assists the drying process. The two drying felts 24 and 27 are additionally provided with normal felt driers 32 and 33.

After the paper web has left the last upper drying cylinder 31 at the doctor of that cylinder, the web is blown onto a conveyor band of a cooling cylinder 34. The conveyor band transports the paper web to the cooling cylinder 34 from which it is removed by a doctor, the movement of the paper web being again assisted by air currents emerging from a holder of the doctor. In this case however cold air is used.

The conveyor band of the cooling cylinder 34 is in this case not a felt but an open metal webbing or a webbing of other materials having good heat conductivity. Thereby an intensive cooling of the paper web is possible, which could not be achieved with poorly conductive felts as used in constructions hitherto known.

In order to remove the paper web from the casing of the drier part should any difficulties arise in the drier part, a large movable flap 35 is provided on the casing near the point where the paper web leaves the felt 18 of the last press. When the flap 35 is opened a strong air current from a blower pipe 36 blows the paper web out of the casing.

From the above description it will be seen that the construction of paper making machines in accordance with the present invention is essentially more advantageous than the hitherto usual construction. A simpler guiding of the entire paper web is achieved, so that a considerable reduction in operating personnel can be made. Moreover the web is to a great extent protected and at the same time a higher thermal efficiency with more economic means is obtained.

An arrangement according to the present invention, of a paper making machine with an automatic removal cylinder is illustrated in FIG. 2. The same subdivision into sieve, press, and drier parts exists as is used in the machine of FIG. 1. The lighter parts of the paper making machine occupy a higher position than the heavier parts. The automatic removal cylinder, which is heavy, lies lowermost, and does no longer, as was hitherto necessary, require its own machine framework, but can be mounted on an extension of the foundations of the machine. The effect of the pre-heating action on the felt of the last press before the drier part is here obtained for a bearing press 37 of the automatic removal cylinder. Here the press 37, with its guide roll, is mounted above the automatic removal cylinder and a felt 39 is housed in an extension of an air channel 38 for hot air flowing away from the drying cylinder. The felt 39 extends for a considerable length into the channel 38. Although no preheating of the paper web is possible, nevertheless by the preheating of the felt already an essential part of the waste heat is utilized. Furthermore, it is possible without any difficulty to employ, before the press 37, a reversing press 14 as described in FIG. 1, as second press, and to utilize the felt of this second press for pre-drying the paper web in the same manner as has been described in connection with multiple cylinder machines.

Since for obtaining a satisfactory degree of smooth-

ness of the paper web, it is sufficient if the web is introduced into the automatic removal cylinder, which has a calender action, with a dryness degree of 50 to 55%, a removal of water from the paper web up to this dryness degree by the already previously described drying on the felt of the last press is very advantageous. Thereby it is achieved that the size of the automatic removal cylinder can be considerably reduced so that construction costs of the machine are lower and the transport and erection of the machine facilitated.

In connection with FIG. 2 it should additionally be mentioned that hot air may be blown through a tube 40 into the casing of the automatic removal cylinder, the hot air being again heated in the usual manner by a heater. The paper web is removed by the doctor in the manner already described and is blown away from the same through an appropriate channel to a take-up roller and finally rolled up.

The waste air from the cylinder is conducted by the air channel 38 to the open, or is further utilized in known manner, for example in connection with preheating the drying air being blown into the tube 40.

An arrangement according to the invention of a paper making machine for making paper which is smooth at one side, and having a pre-drier, is illustrated in FIG. 3.

Since on the one hand for a paper smooth at one side, the paper web is brought onto a calender cylinder with a 50 to 55% dryness degree, in order to receive a satisfactory smoothing on the calender cylinder, and since on the other hand in connection with these machines, which also produce machine smooth paper, the requirement exists that machine smooth paper has to be ready dried in the entire drying arrangement, the pre-drying of the paper web in a waste air channel 41 has been increased. Beside the felt 39 of the bearing press and the metal sieve already described, which lies on the said felt, a second metal sieve 42 is used which lies above the metal sieve which is in contact with the felt 39. The paper web is conducted by the second press onto the upper side of the lower metal sieve and is held by the upper metal sieve 42. Then the web is conducted in the manner already described to the felt of the bearing press and to the automatic removal cylinder. Thereby the drying surface available for pre-drying is considerably increased so that a drying of the paper is effected even in connection with machine smooth paper without using cylinder dryers, solely by the air pre-drying and the subsequent automatic removal cylinders.

In connection with machine smooth paper, in order to enable feeding forwards of the web, the drying air which is conducted through the tube 40, on feeding of the web, is conducted not to the exit end of the automatic removal cylinder, but to the input end by means of an extension of the tube 40, with a flap control. The air then flows through a hood of the cylinder (Yankee drier cylinder) in its direction of rotation.

In order to further facilitate the conducting of the machine smooth paper, the hot air which is fed through the tube 40 can be turned off so that the drying of the paper web between the metal sieves and on the felt of the bearing press is very low, and the paper web, as in the manufacture of paper smooth and at one side, adheres to the surface of the automatic removal cylinder.

What I claim is:

1. In a paper making machine having a sieve part, a press part comprising a plurality of presses, and a drier part comprising an air drier and at least one cylinder drier the improvement which comprises mounting the sieve part in the uppermost part of the machine, mounting the press part at a level beneath the level of the said sieve part and mounting the drier part at least partially at a level beneath the levels of both of said sieve and press parts whereby the web of paper after it is picked

up from said sieve part passes by virtue of its weight from the first of said plurality of presses to the last of said cylinder driers and wherein said web of paper after it passes the last press of said plurality of presses and before it passes into the first of said cylinder driers passes through an air channel located above the said cylinder drier and through which waste heated air from the said cylinder drier is being flowed.

2. A machine as claimed in claim 1 wherein each of said presses comprising said plurality of presses is arranged in succeeding order at a level below that of the preceding press.

3. Machine as claimed in claim 1 including a pick-up felt for picking up said web of paper from said sieve part and conveying the web to the first of said presses, a liquid-pervious felt associated with each of said presses of said plurality of presses for conveying the web past said presses and a liquid pervious felt for conveying the paper web from the last of said presses to the first of said cylinder driers, said last mentioned liquid pervious felt passing through said air channel located above said cylinder driers, whereby the heated air flowing through said channel heats and dries said liquid pervious felt.

4. Machine as claimed in claim 3 wherein a sieve is provided for holding the paper web onto the felt associated with the last of said presses, and within the said drier part, the said sieve being arranged for movement in the same direction as the said felt.

5. Machine as claimed in claim 4 wherein the said sieve is arranged for being heated by an electric current.

6. Machine as claimed in claim 2 including means associated with said felts, through which compressed air can be blown, whereby the paper web in its path of movement can be separated from the felt carrying the web at the respective point in said path of movement.

7. Machine as claimed in claim 1 wherein said drier part comprises a plurality of cylinder driers, said cylinder driers being divided into two groups each of said groups being mounted at a different level designated one of upper and lower, said upper and lower cylinder driers being provided with doctors mounted on carriers arranged for being supplied with compressed air, the drying felts of the lower cylinders being conducted so closely to the upper cylinders and drying felts of the upper cylinders so closely to the lower cylinders, that under the action of the compressed air emerging from the doctor carriers a transfer of the paper web from one cylinder to the next succeeding cylinder is effected.

8. A machine as claimed in claim 1 including a casing surrounding the drier part of said machine, the casing having an aperture positioned in the direction of travel of the web leaving the felt of the last of said presses of the press part and which upon being opened serves simultaneously for establishing a strong current of compressed air for blowing the paper web through the aperture in the said casing and into the surrounding air.

References Cited in the file of this patent

UNITED STATES PATENTS

1,140,711	Pope	May 25, 1915
1,163,254	Millsbaugh	Dec. 7, 1915
1,326,615	Pope	Dec. 30, 1919
1,688,267	Cram	Oct. 16, 1928
1,734,879	Read	Nov. 5, 1929
2,006,499	Fourness et al.	July 2, 1935
2,091,805	Chuse	Aug. 31, 1937
2,340,103	Berry	Jan. 25, 1944
2,667,106	Hyman et al.	Jan. 26, 1954

FOREIGN PATENTS

77,714	Sweden	Apr. 2, 1931
--------	--------	--------------