

Feb. 8, 1966

R. POESCHL ETAL

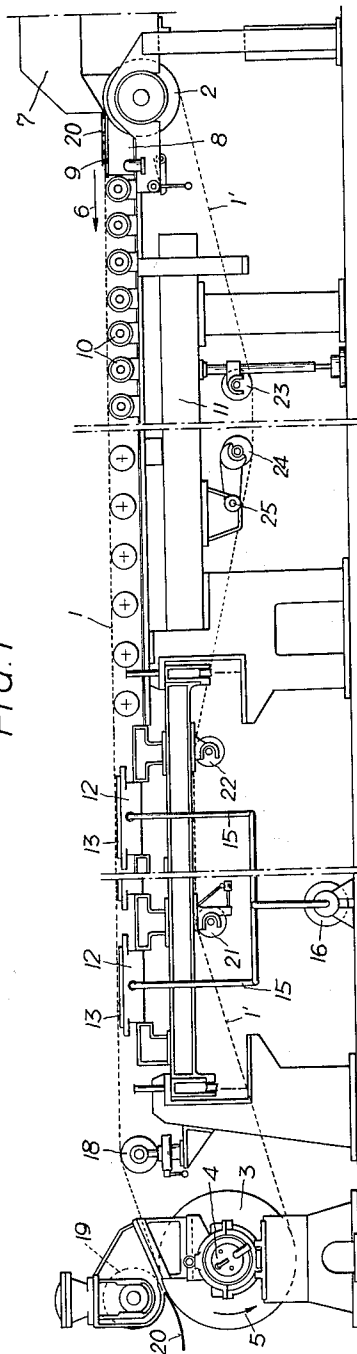
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PAPERMAKING MACHINE HAVING A POLYETHYLENE SUCTION BOX TOP

Filed Feb. 4, 1963

2 Sheets-Sheet 1

FIG. 1



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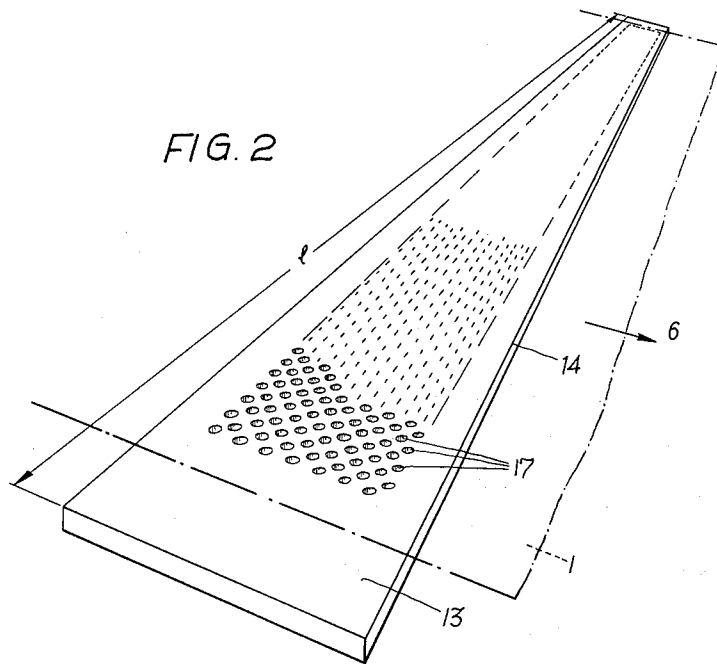


FIG. 3

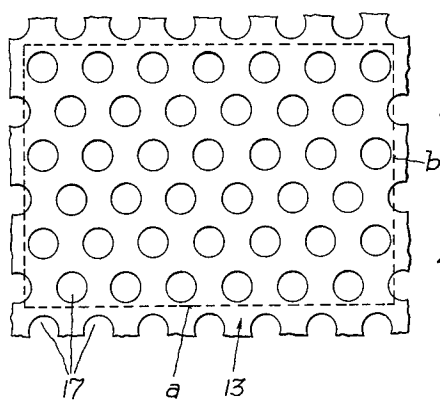
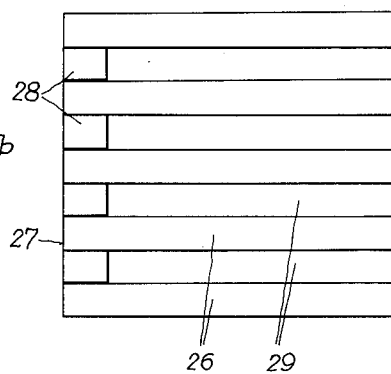


FIG. 4



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PAPERMAKING MACHINE HAVING A POLY-ETHYLENE SUCTION BOX TOP

Rudolf Poeschl, 135 Mariahilferstrasse, Vienna, Austria,
and Wilhelm Poeschl, Rohrbach, Oberosterreich, Austria

Filed Feb. 4, 1963, Ser. No. 256,659

Claims priority, application Austria, Feb. 7, 1962,

A 996/62; May 11, 1962, A 3,890/62

24 Claims. (Cl. 162—374)

Machines for extracting water from paper and pulp are in continuous operation in most cases during the day and night and their output depends on the speed of the machine wire. For this reason an increase in the speed of the wire will result in a proportional increase in output. On the other hand, a certain extraction of water from the stock must be effected in the wire end of the machine under the action of the vacuum on the wire. If the speed of the wire is increased, the vacuum-action on the wire must also be increased. This involves an increase in the pressure with which the wire is forced on the suction box tops so that the friction between the wire and the suction box tops is increased in the same proportion and with it the tension required for driving the wire. The wire is driven by the couch roll. At a given tension of the wire, only a limited driving force can be transmitted by the couch roll to the wire. On the other hand, the number of the wire in a paper machine depends on the grade of paper to be manufactured so that the number of the wire cannot be increased. In the known paper machines, the speed of the wire is so chosen as to reach just the limit at which the drive of the wire by the couch roll is ensured under a vacuum action sufficient for the required extraction of water at this speed of the wire whereas the allowable stress of the wire is not exceeded. Hence, an increase in the speed of the wire and an increase in output cannot be achieved with the known machines.

Because in these known machines the wire is loaded to the allowable limit, a relatively rapid wear of the wire must be expected. This requires a relatively frequent replacement of the wire. Considerable costs and a shutdown of the machine are involved in the renewal of the wire. Because such machines are in continuous operation during the day and night, as has been mentioned before, this shutdown results in a reduction in output. To reduce the wear of the wire, it has already been proposed to make the suction box or forming board tops of a plastic which is softer than the material of the wire so that the wear of the latter is reduced. While this enables an increase in the intervals of time after which the wire must be replaced, the wire is still subject to considerable wear and the output of the machine cannot be increased. Such suction box tops consist of plastic plates on a backing consisting, e.g., of wood or metal. This two-layer material has the disadvantage that the walls of the holes in the suction box tops are uneven, particularly at the joint between the two layers, and these uneven portions promote an accumulation of sucked-off fiber material on the walls of the holes so that the holes in the suction box tops are gradually reduced in cross section. For this reason, such suction box tops must be frequently cleaned, which results again in a shutdown and reduction in output.

It is an object of the invention to eliminate these disadvantages and to increase the output of machines for extracting water from paper or pulp. The invention resides in a machine for treating paper or pulp, a machine wire for receiving the material to be treated, means, such as at least one suction box and/or at least one forming board for extracting water from the material to be treated, said means having sliding surfaces on their tops, on which the machine wire slides, said tops consisting of a polyethyl-

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ene plastic softer than the material of the wire, whereby the coefficient of friction between the machine wire and the tops is less than 0.12, so that the speed of the wire is increased by a reduction of the slip of the wet wire driving roller and whereby the tops made only from this plastic are stable in shape and self-supporting and have an active water-extracting area of at least 40% of the water-extracting zone to increase the extraction of water from the stock. In conjunction with the fact that the material of the suction box and/or forming board tops is softer than the material of the machine wire, the low coefficient of friction of the plastics used ensures a particularly low wear of the wire and it has been found that the wear of the suction box and forming board tops is extremely small. As a result, stoppages for a replacement of the wire will be minimized. Owing to the reduction of the frictional resistances, the active water extracting area of the suction box tops can be increased, which results in an increase of the rate at which water is extracted from the stock so the speed of the wire can be increased whereas the tensile stress required in the wire to enable a substantially slip-free drive thereof by the couch roll does not exceed the allowable stress. In this connection, the term "active water extracting area" is the ratio of the area of the openings in the suction box tops to the entire area of a rectangle which defines the water extracting zone, as will be explained with reference to the drawing.

It has been found that the narrow lands remaining between the suction holes if the forming board and/or suction box tops are designed according to the invention and a relatively large active suction area is provided, will not break out because the material withstands the stresses involved in surfacing the tops. The fact that the suction box and/or forming board tops are stable in shape and self-supporting has the further advantage that the need for the previously required backings for the suction box and/or forming board tops is eliminated. As a result, the joint formed between the two layers at the walls of the holes and promoting an accumulation of fiber material is also eliminated and the cleaning of the suction box and forming board tops, which cleaning involves a shutdown, may be performed in much longer intervals of time. The known backings consisting, e.g., of wood, have always involved difficulties because their degree of swelling was different from that of the material of the suction boxes so that warping occurred, which had to be eliminated by subjecting the table top to a time-consuming surfacing operation.

The materials used according to the invention for the suction box and/or forming board tops are stable up to temperatures above 100° C. This affords the advantage that the stock can be applied in boiling condition without damage to the forming board and/or suction box tops. The application of the stock in boiling condition has become increasingly popular in recent years. In a preferred embodiment of the invention, sintered low-pressure polyethylene having a molecular weight of about 1,000,000 is used as a plastic. This material has a particularly high impact strength so that forming board and/or suction box tops made from this material can be surfaced by surfacing machines having surfacing knives rotating at high speed. It has been found suitable to charge this material as a powder into an elongated mold and to sinter it there under a high pressure and at an appropriate temperature. Plates of any desired size which are made from such material have a particularly low coefficient of friction with respect to the wire so that the coefficient of friction between the wire, on the one hand, and the forming board and/or suction box tops, on the other hand, may be reduced below 0.1, in accordance with the invention. In spite of the resulting further

increase in the speed of the wire, a satisfactory extraction of water will be obtained if the active suction area is at least 50%, preferably about 60% of the suction zone. The very narrow lands left between the suction holes in the case of such a large active water extracting area will resist even impact stresses applied when the suction box and/or forming board tops are surfaced with the aid of a machine.

In a preferred embodiment of the invention, the plastic material of the suction box and/or forming board tops has admixtures which reduce friction and, if desired, are electrically conducting. These admixtures may be added in the form of powders and may consist of molybdenum sulfide powder or molybdenum disulfide powder, on the one hand, and graphite powder, on the other hand. The total amount of these admixtures is less than 5 percent by weight, preferably between 1 and 3 percent by weight.

At high speeds of the wire, adverse circumstances may coact to cause an electrostatic charging of the suction box and/or forming board tops. This electrostatic charge may result in an accumulation of dirt, which may build up to the size of a fingernail and is then suddenly torn off into the path of the stock. Such a charging of the tops may be prevented by the electrically conducting admixtures added to the plastic material of the suction box and/or forming board tops. The electrically conducting admixtures impart to the suction box and/or forming board top such a conductivity that the electrostatic charges will be dissipated. Molybdenum has an effect similar to that of a lubricant whereas graphite powder imparts an electrical conductivity to the plastic. Owing to the relatively small total amount of the admixtures, the plastic nature of the suction box and/or forming board tops is preserved and with it those properties of the tops which are due to this plastic nature, namely, the resistance to acid, the stability of shape, the resistance to swelling, low wear and temperature stability etc. Instead of molybdenum sulfide or molybdenum disulfide, on the one hand, and graphite powder, on the other hand, other substances which reduce friction and/or impart electrical conductivity may be added to the plastic. For instance, the plastic material may contain about ½ percent by weight of molybdenum sulfide powder or molybdenum disulfide powder and about ½ percent by weight of graphite powder. These additions of dry lubricants result in a particularly great reduction of the friction between the suction box tops and the wire and thus enable a considerable increase in the suction effect and wire speed resulting in a considerable increase in output. It has been found that in this way the wire speed and the output can readily be increased by about 20% while a satisfactory extraction of water from the stock is maintained.

The particle sizes of the admixture will depend on the nature of the plastic material to be processed and on the nature of the friction-reducing or electrically conducting admixtures. According to the invention, the particle size of the admixtures may be between 5 microns and 0.05 micron, preferably in the range between 2 microns and 0.2 micron. Favorable results are obtained, e.g., with molybdenum sulfide powder having a particle size below 2 microns, and best results are achieved with particle sizes of 0.4 micron or 0.2 micron.

In the manufacture of the suction box and/or forming board tops of plastic, the admixtures in powder form are added to the plastic powder. This is followed by mixing and subsequently the tops can be made by sintering, molding, extruding or the like. The plastic material will establish an intimate bond with the admixtures.

It is also possible within the scope of the invention to make the suction box and/or forming board tops in one piece in order to avoid vacuum defects which would interrupt the operation. This is of special importance because even very small disturbances in the charging and distribution of the stock on the wire will result in undesirable effects in the finished roll. If the paper does not

have a uniform thickness throughout, the roll cannot be cylindrically wound but will have humps due to a repeated summation of micro defects. For this reason it is highly desirable that the suction box and/or forming board tops should be maintained as truly planar as possible in order to avoid an impression of uneven portions into the stock. The planar form of the suction box and/or forming board tops can best be maintained if they are made in one piece. Alternatively, suitably shaped elements which are conveniently interconnected may be used.

Within the scope of the invention, best results will be obtained if that surface of the suction box and/or forming board top which cooperates with the wire is polished, preferably to a high finish. In this case, extremely low coefficients of friction may easily be obtained; these values may be less than 0.095 or even less than 0.09.

In connection with the known forming board and/or suction box tops, the stock inevitably entrained by the water draining through the wire was able to build up in the holes of the forming board top because these holes were always fairly rough, particularly under the influence of the moisture. For this reason it has been attempted to provide suction box tops with upwardly tapering holes to prevent an interruption of the vacuum by entrained stock built up in the holes. The present invention contemplates the provision of suction holes which are polished, preferably to a high finish, so that a build-up of the entrained stock on the walls of the suction holes is prevented to a large extent. It is also of special importance that the perfect smoothness of the highly finished holes is maintained during the operation because the materials used according to the invention are resistant to acids and alkalis in concentrations up to 5% at temperatures much above 100° C. Otherwise the high finish of the suction holes would soon be destroyed by the action of acids and/or alkalis. The polishing of the holes to a high finish is facilitated by the ease with which the materials used according to the invention can be machined. Machining can easily be carried out in a simple manner with all wood-working tools, including milling cutters. This is prompted by another property of sintered low-pressure polyethylene having a high molecular weight, and of molded or extruded polyethylene or the like, namely, the fact that these materials are free of internal stresses.

Other plastics which may be used according to the invention include extruded polypropylene and extruded polyester and polyether products, provided that they have properties similar to those of polyethylene.

Example 1

A suction box top 4000 millimeters long and 350 mm. wide is to be made and to be provided with holes in a zone having a length of 3000 mm. and a width of 280 mm. The holes are arranged so that relatively wide lands remain between the suction holes of the top. For this purpose, parts of a non-apertured plate of polyethylene are made by injection molding and are then drilled in the usual manner with a drilling machine. Having a thickness of 40 mm., the individual elements are arranged in a row without the provision of a backing and are directly connected to the suction box by countersunk screws so that the fastener lies in the lowermost 10 mm., which is the limit to which the top can be machined, for technical reasons. Because the lands which remain between the holes have a width of 15 mm., these parts can be surfaced with any milling, planing or other surfacing machine.

Example 2

A suction box top 5000 mm. long and 500 mm. wide is to be made in one piece in order to avoid vacuum defects and uneven portions due to joints and to increase the stability of the top and enable a simple mounting thereof.

The active water extracting area of this plate is 60% of the zone formed with holes. This requires the provision of holes of 12 mm. and the lands remaining between the holes are only 3.5 mm. wide. Depending on the fact whether a low or a very low coefficient of friction is required for increasing the wire speed, polyethylene or sintered low-pressure polyethylene having a low molecular weight (about 200,000) and a particularly low coefficient of friction will be used. If suction holes polished to a high finish are also to be used, the use of sintered low-pressure polyethylene having a high molecular weight (about 1,000,000) is recommended. This material will not take up water and will resist the impacts occurring during machining. The chemical stability of the material will ensure that the high finish will be preserved during operation even if boiling stock is charged.

Example 3

Suction box strips for use with suction boxes having a strip top are to be made. These suction box strips may be made, e.g., from non-apertured suction box top plates by cutting them to suitable length. If the strip has an overall thickness of, e.g., 30 mm., it may be connected to the suction box by screws disposed in the lowermost 10 mm.

The coefficients of friction which have been stated are applicable with respect to bronze wire. Wire of other materials, particularly of plastic, may be used, provided that this will not result in a substantial increase in the coefficients of friction stated above.

Embodiments of the invention are shown by way of example in the drawing.

FIG. 1 is a side elevation showing the wet end of a paper machine. FIG. 2 is a perspective view showing a suction box top. FIG. 3 is a fragmentary top plan view showing a suction box top and FIG. 4 is a fragmentary plan view of a different form of a suction box top.

In the wet end of the paper machine shown in FIG. 1, a machine wire 1 runs around a breast roll 2 and a lower couch roll 3. The lower couch roll 3 is driven by an electric motor 4 and forms the driving member for the wire 1. The breast roll 2 is a reversing roll, which is not driven. The direction of rotation of the lower couch roll 3 is indicated by arrow 5 and the direction of movement of the wire 1 is indicated by arrow 6. The stock consisting of fiber pulp is charged from a hopper 7 onto the wire 1. The wire runs over a forming board 8, which is closed at its top by an apertured top 9. The forming board 8 is formed by a trough, into which a large portion of the liquid is drained out of the stock through the apertured top 9. From the latter, the wire 1 moves over a plurality of wire guide rolls 10, which cause further liquid to drain through the wire. The liquid flows from the wire guide rolls 10 into a trough 11 which constitutes at the same time a frame of the machine.

Behind the wire guide rolls, considered in the direction of movement of the wire, suction boxes 12 are arranged, which are closed at the top by suction box tops 13, over which the wire 1 moves. The suction box tops 13 have the same design as the top 9 and in FIG. 2 it will be seen that length *l* of the suction box top 13 corresponds to the width of the machine. These suction box tops 13 are in one piece and their longitudinal edge 14 extends transversely to the direction of movement of the wire 1 as shown by the arrow 6. The suction boxes have the form of hollow troughs and are connected by conduits 15 to a vacuum pump 16, by which a vacuum is produced in the suction boxes 12. The suction box tops 13 are formed with holes 17, over which the liquid is sucked out of the stock through the wire 1. Behind the last suction box 12 the wire 1 runs over a deflecting roll 18 to the lower couch roll 3. 19 is the upper couch roll, which is not driven and serves only to press the wire and the web of stock 20 lying on the wire. Behind the couch

roll, the web of stock 20 is removed and passed onto the dryer felt, which is not shown.

The returning lower course of the wire is designated at 1'. This returning course 1' moves over stationary guide rolls 21, 22 and vertically adjustable rolls 23 back to the breast roll 2. 24 is a dancer roll. The machine wire 1 is endless and the tension of the wire is adjusted by the vertically adjustable rolls 23 and the dancer roll 24. The lowering of the vertically adjustable rolls 23 will increase the tension of the wire. These vertically adjustable rolls 23 can be adjusted in accordance with the length of the wire. The dancer roll 24 is pivotally movable about a shaft 25 and is urged by gravity onto the wire 1 to effect an automatic adjustment of the tension of the wire. The tension of the wire 1 must be so high that the lower couch roll 3 is capable of driving the wire.

FIG. 3 is a top plan view showing a portion of the suction box top 13. It serves to define the expression "active water extracting area." A rectangle having sides *a* and *b* is shown in dotted lines and is assumed to have an area *Y*. The cross-sectional areas of the circular holes in the rectangle *a*, *b* is assumed to be *X*. The active water extracting area equals the quotient $X/Y \times 100\%$. This active zone water extracting suction area is at least 40% of the water extracting zone.

The circular holes 17 may be replaced by elongated holes extending transversely to the direction of movement of the wire.

FIG. 4 is a top plan view showing a suction box top 13 which is formed by spaced apart strips 26 which extend transversely to the direction of movement 6 of the wire 1. Inserts 28 are provided between the strips 26 at the edges 27 of the top 13. The spaces 29 between the strips 26 form the suction holes.

What we claim is:

1. In a machine for treating paper or pulp, a machine wire for receiving the material to be treated, a wire driving roller and means cooperable with the wire for extracting water from the material to be treated, said means having tops provided with sliding surfaces on which the machine wire slides, said tops being composed substantially of a polyethylene-plastic softer than the material of the wire, the coefficient of friction between the machine wire and the tops being less than 0.12 so that the speed of the wire is increased, the tops formed only from this plastic being stable in shape and of sufficient thickness to be self-supporting and have an active water extracting area of at least 40% of the water extracting zone to increase the extraction of water from the stock.

2. The machine as claimed in claim 1, wherein the polyethylene-plastic is sintered low-pressure polyethylene.

3. The machine as claimed in claim 1, wherein the polyethylene-plastic is molded polyethylene.

4. The machine as claimed in claim 1, wherein the polyethylene-plastic is extruded polyethylene.

5. The machine as claimed in claim 1, wherein the polyethylene-plastic is sintered low-pressure polyethylene having a molecular weight of about 1,000,000.

6. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction.

7. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures which are electrically conducting for dissipating electrostatic charges.

8. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction and admixtures which are electrically conducting for dissipating electrostatic charges.

9. The machine as claimed in claim 1, wherein the polyethylene-plastic contains the admixtures of the group consisting of molybdenum sulfide powder or molybdenum disulfide powder in an amount up to 3 percent by weight for reducing friction.

10. The machine as claimed in claim 1, wherein the polyethylene plastic contains admixtures consisting of

graphite powder in an amount up to 3 percent by weight for dissipating electrostatic charges.

11. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures of the group consisting of molybdenum sulfide powder or molybdenum disulfide powder and graphite powder and in an amount up to 3 percent by weight for reducing friction and dissipating electrostatic charges, respectively.

12. The machine as claimed in claim 11, wherein the plastic material contains about ½ percent by weight of molybdenum sulfide powder or molybdenum disulfide powder and about ½ percent by weight of graphite powder.

13. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction with the particle sizes of the admixtures being between 5 microns and 0.2 micron.

14. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures which are electrically conducting for dissipating electrostatic charges with the particle sizes of the admixtures being between 5 microns and 0.2 micron.

15. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction and admixtures which are electrically conducting for dissipating electrostatic charges with the particle sizes of the admixtures being between 5 microns and 0.2 micron.

16. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction with the particle sizes of the admixtures being between 2 microns and 0.5 micron.

17. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures which are electrically conducting for dissipating electrostatic charges with the particles sizes of the admixtures being between 2 microns and 0.5 micron.

18. The machine as claimed in claim 1, wherein the polyethylene-plastic contains admixtures for reducing friction and admixtures which are electrically conducting for dissipating electrostatic charges with the particle sizes of

the admixtures being between 2 microns and 0.5 micron.

19. The machine as claimed in claim 1, wherein each top of each means for extracting water from the stock is in one piece.

20. The machine as claimed in claim 1, wherein the sliding surfaces of the tops are polished.

21. The machine as claimed in claim 20, wherein the coefficient of friction between the wire and the sliding surfaces of the tops is less than 0.1.

22. The machine as claimed in claim 1, wherein the tops are provided with polished holes.

23. The machine as claimed in claim 1, wherein the active water extracting area is at least 50% of the water extracting zone.

24. The machine as claimed in claim 1, wherein the active water extracting area is about 60% of the water extracting zone.

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MORRIS O. WOLK, *Examiner*.