UNITED STATES PATENT OFFICE.

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SURFACE-FINISHING MACHINE FOR PAPER.


To all whom it may concern:

Be it known that I, HENRY P. HOWE, a citizen of the United States of America, and resident of Holyoke, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Surface-Finishing Machines for Paper, of which the following is a full, clear, and exact description.

This invention relates to a machine for the finishing of paper, and particularly to improved means for imparting a cloth-like surface finish to the paper while being run in web form therethrough.

The invention, furthermore, relates to means comprised as a part of the machine or apparatus for the drying of the paper which is subjected to the surface finishing action in a somewhat moist condition, but which emerges from the machine entirely dry, and calendered as well.

Inasmuch as it is impracticable in machines for imparting a cloth-like finish to the surface of paper to employ cylinders on which the cloth covering thereof entirely surrounds the cylinder, owing to the fact that a seam mark would be necessarily made across the web, it is necessary to cover but part of the periphery of the cylinder with the cloth which is held thereon in tight or stretched condition by having the end portions thereof carried within recesses or reduced peripheral portions of the cylinder; and the principal object of this invention is to so combine and arrange the cylinders, having coöperative cloth finishing surfaces comprised in a portion of the circumference of each cylinder, in sets, that those of one set are operable to impart the surface finishing to the running web in separated portions in the length thereof, while a succeeding set of the cylinders imparts a surface finishing to the portions of the web which are intermediate between the portions finished by the preceding set of cylinders.

Another object of the invention is to provide means whereby the drums comprised in the drying portion of the machine may be driven at a slightly lessened surface speed than that of the cylinders which impart the cloth-like finish to the paper to compensate for the shrinkage of the latter. And other objects are to generally improve and simplify the construction of the machine to the end of increased efficiency, durability and the avoidance of liability of derangement after protracted use.

The invention is described in conjunction with the accompanying drawings and is set forth in the claims.

In the drawings:—Figure 1 is a plan view, and Fig. 2 is a side elevation of the improved paper surface finishing machine. Fig. 3 is a sectional elevation through a portion of the machine, on a larger scale, as taken on line 3—3, Fig. 1. Fig. 4 is a cross sectional view on line 4—4, Fig. 1. Fig. 5 is an end view of one of the cylinders. Figs. 6, 7, 8 and 9 are diagrammatical views to show as plainly as possible the mode of action of successive sets of the surface finishing cylinders.

Similar characters of reference indicate corresponding parts in all of the views.

In the drawings:—A represents the framing of the machine, the opposite side portions of which have horizontal longitudinally extending straight edged recesses a in which are slidable journal boxes B for the several cylinders which perform the cloth-like surface finishing upon the paper. Said cylinders are comprised in what may seem to be distinctly different sets, those 1, 2 and 3 constituting the first set while those designated by 4, 5 and 6 constituting the second set.

Each cylinder has a surface finishing peripheral face b comprising a circumferential portion thereof and a reduced portion d comprised in the remainder of the perimenter of the cylinder. In practice the "full" or truly circumferential portion b of each cylinder extends around the latter for slightly more than a half full of the perimeter and the cloth covering e overlies the "full" portion of the cylinder and is extended within the reduced opposite portion of the cylinder, engaged with the tensioning rod f disposed within the cavity d within the reduced portion d,—the ends of the cloth being in such winding engagement

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with the rod that by the rotation thereof the cloth may be tensioned in the proper degree. The rod is provided with a ratchet wheel \( \mathcal{J} \) coating with which is a spring pressed pawl \( \mathcal{J} \) for maintaining the security of the cloth covering in its tensioned condition.

The cylinders of each set have their cooperative surface finishing “full” peripheral faces comprising approximately the half circumference all faced the same way, while the cooperative faces of the next set are in reversed relation to the corresponding faces of the cylinders of the first set as is fully shown in Figs. 2, 3, and 6 to 9.

The cooperative surface finishing faces of one set of the cylinders are effective for imparting the surface finishing of the running web of paper in separated portions in the length thereof, while the succeeding set of the cylinders, in reversed relation to those of the first set (cylinders 1, 2 and 3 being compared with cylinders 4, 5 and 6) impart the surface finishing to the portions of the running web which are intermediate of the portions finished by the first set.

All of the cylinders of the set are held in hard peripheral bearing as insured by the screw shafts D D, threading horizontally and longitudinally through the machine frame and having forcing engagements against the slidable journal boxes of the first and last cylinders of the series—all of the intermediate boxes being slidable so that the cylinders journaled therein may be forced in such manner as to maintain the cooperative full peripheral finishing faces \( \mathcal{A} \) in tightly contacting relations.

The springs \( \mathcal{G} \) are applied, between the adjacent boxes, under considerable compression, and they prevent the approaching of the adjacent cylinders when their reduced and non-cooperative portions are brought around into conjunction.

The first and second sets of cylinders, 1, 2, 3 and 4, 5, 6, are effective for imparting repeated surface finishing actions to the separated areas in the running web.

By reference to the diagram, Sheet #3 of the drawings, it will be seen that the portions \( \mathcal{A} \) of the paper is first subjected to pressure and surface finishing action between cylinders 1 and 2 and then again between cylinders 2 and 3. The portion \( \mathcal{A} \) of the paper which has received repeated surface finishing actions between rolls 1, 2 and 3, thence in passing in relation to the rolls 4, 5 and 6, is not acted upon by these rolls, but the portion \( \mathcal{A} \) relatively intermediate of the paper finished by the first set of cylinders receives repeated surface finishing first in passing between the cooperative faces of cylinders 4 and 5 and then again between cylinders 5 and 6.

In the diagrammatic views the portions of the paper represented by solid black and designated by \( \mathcal{A} \) are those dealt with by the cylinders of the first set, while the portions of the paper represented by the separated lines and designated \( \mathcal{A} \) are those dealt with by the cylinders of the second set. The arbores of all of the cylinders have intermeshing spur gear wheels \( \mathcal{G} \) \( \mathcal{U} \), the entire train being driven by the spur gear \( \mathcal{H} \) on the driving shaft \( \mathcal{J} \) of the machine for which the pulley \( \mathcal{J} \) and driving belt \( \mathcal{J} \) are provided.

Forward of the surface finishing cylinders is a calender stack \( \mathcal{K} \), and forward of the latter is a drying apparatus comprising rotative drier drums \( \mathcal{L} \) \( \mathcal{L} \)—having gearing connections one with another, as usual, the paper being conveyed, after being let off from the roll \( \mathcal{A} \) at the rear of the machine, and which roll is supported by the brackets \( \mathcal{A} \) \( \mathcal{A} \) through the surface finishing cylinders, thence to the top of and down through the calender rolls, and thence to and around the rotary drier drums.

The web provided in roll form and supported on the brackets \( \mathcal{A} \) is usually in a more or less moist condition as having been taken from the Fourdriner machine after being subjected to but partial drying. The lower one of the calender rolls is driven by having a pulley \( \mathcal{K} \) on its arbor, driven by a belt \( \mathcal{K} \) from a pulley \( \mathcal{K} \) on a shaft \( \mathcal{K} \) which is provided with a gear wheel \( \mathcal{K} \) in mesh with one of the cylinder gears \( \mathcal{G} \). The drums of the drier receive rotation by one thereof having on the arbor or journal shaft thereof a pulley \( \mathcal{L} \) driven by belt \( \mathcal{L} \) from a pulley \( \mathcal{L} \) on a shaft \( \mathcal{L} \) which has a cone pulley \( \mathcal{L} \) thereon. A reverse cone pulley \( \mathcal{L} \) is affixed on a shaft \( \mathcal{L} \) which by gear \( \mathcal{L} \) is in meshing engagement with one of the surface finishing cylinder gears \( \mathcal{G} \). The belt \( \mathcal{L} \) runs around the reversed cone pulleys and the driving means described for the drier drums operated by connection with the driving means for the surface finishing cylinders is of such character that the surface speed of the paper while passing in more or less nearly dried and shrunk condition around the drier drums may be slightly reduced, the reduced running speed being susceptible of regulation by the adjustment of the belt \( \mathcal{L} \) on the cone pulleys as manifest.

The springs \( \mathcal{G} \) in compression between the journal boxes of the surface finishing cylinders exert at all times a separating force on the cylinders, so that while their reduced portions are brought around to conjunction such reduced portions may not by any possibility be brought to contact to cause shock, noise, and injury to the web.

Although usually the cooperative full peripheral faces of the cylinders in sets and arrangement as described are overlaid by tightly drawn textile fabric, other covering material for such faces may be employed; and while in practice a finishing machine
having two sets of cylinders, of three cylinders in each set, is efficient for satisfactory surface finishing results, the machine may be employed wherein the cylinders of the two sets, having the formation and arrangement described, may be two to the set; or more than three to the set may be employed; and the number of the cylinders comprised in the one set need not necessarily be the same as that comprised in the other set.

1 claim:—

1. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, those of each set being circumferentially contiguous one to another and having coöperative surface-finishing peripheral faces comprising circumferential portions of the cylinders and reduced and non-coacting parts comprising other circumferential portions of the cylinders, the coöperative surface finishing faces of one set of the cylinders being effective for imparting the surface finishing of the running web of paper in separated portions in the length thereof, while the succeeding set of the cylinders have their coöperative faces so relatively positioned that they impart the surface finishing to the portions of the web which are intermediate between the portions of the web finished by the portion finished by preceding set of cylinders.

2. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter coöperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their coöperative peripheral faces all at the same sides of such cylinders while the coöperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set.

3. In a surface finishing machine for paper, a plurality of sets of cylinders, those of each set having coöperative surface finishing peripheral faces comprising circumferential portions of the cylinders and reduced and non-coacting parts comprising other circumferential portions of the cylinders, the coöperative surface finishing faces of one set of the cylinders being effective for imparting the surface finishing of the running web of paper in separated portions in the length thereof, while the succeeding set of the cylinders have their coöperative faces so relatively positioned that they impart the surface finishing to the portions of the web which are intermediate between the portions finished by the preceding set of cylinders, means for maintaining the cylinders with their coöperative faces in pressure bearing relations, and spring means for preventing the cylinders from approaching one another while the reduced portions thereof are in conjunction.

4. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter coöperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their coöperative peripheral faces all at the same sides of such cylinders while the coöperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, movable journal boxes for the cylinders, and springs between, and exerting separating pressures against, the adjacent boxes.

5. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter peripheral portions and circumferentially reduced portions, the full or peripheral portions of the cylinders being overlaid by a covering of surface finishing sheet material, which is extended to within the said reduced portions, and means within said reduced portions and with which the opposite ends of the sheet material are connected for tensioning the latter,—the cylinders of the one set having their coöperative peripheral faces all at the same sides of such cylinders while the coöperative faces of the cylinders of the next set are in a reversed relation to the corresponding faces of the cylinders of the first set.

6. In a surface finishing machine for paper, a set or plurality of cylinders and a succeeding set of cylinders, one of the sets comprising more than two cylinders, those of each set having coöperative surface finishing peripheral faces comprising circumferential portions, and reduced and non-coacting parts comprised in other circumferential portions of the cylinders, the cylinders of the one set having their coöperative peripheral faces all at the same sides of such cylinders while the coöperative faces of the cylinders of the next set are in reversed relation to the corresponding faces of the cylinders of the first set, the set having more than two of the cylinders being operable to impart repeated finishing actions to separated portions in the length of the paper subjected to the action thereof.

7. In a surface finishing machine for paper, a plurality of sets of cylinders, those of each set including more than two cylinders, said cylinders being circumferentially contiguous one to the next and having coöperative surface finishing peripheral faces comprising circumferential portions of the cylinders and reduced and non-coacting parts comprising other circumferential portions of the cylinders, the coöperative sur-
face finishing faces of one set of the cylinders being effective for imparting repeated surface finishings of the running web of paper in separated portions in the length thereof, while the succeeding set of the cylinders have their cooperative faces so positioned relatively to the corresponding faces of the preceding set that they impart repeated surface finishings to the previously separated unfinished portions of the web which are relatively intermediate of the portions of the paper finished by the preceding set of cylinders.

8. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each cylinder comprising in its perimeter cooperate peripheral surface-finishing faces and circumferentially reduced and non-coacting portions,—each set including more than two of such cylinders,—the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set.

9. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces, and means for rotatively driving the cylinders, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper surface finished by the cylinders is brought and means for rotatively driving the drums.

10. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces, and means for rotatively driving the cylinders, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper surface finished by the cylinders is brought, and means operated by the cylinder driving means for rotatively driving the drier drums.

11. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces, and means for rotatively driving the cylinders, a set of calender rolls, and rotative drier drums forwardly beyond the finishing cylinders and to the action of both of which the paper, surface finished by the cylinders, is brought, and means for rotatively driving the calender rolls and drier drums.

12. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces, and means for rotatively driving the cylinders, a set of calender rolls, and rotative drier drums forwardly beyond the finishing cylinders and to the action of both of which the paper, surface finished by the cylinders, is brought, and means for rotatively driving the calender rolls and drier drums.

13. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces, and means for rotatively driving the cylinders, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper, surface finished by the cylinders, is brought, and mechanism for rotatively driving the drier drums at less surface speed than the surface speed of the cylinders.

14. In a surface finishing machine for paper, a plurality of cylinders having cooperative peripheral surface finishing faces and means for rotatively driving the cylinders, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper, surface finished by the cylinders, is brought, and mechanism for rotatively driving the drier drums at less surface speed than the surface speed of the cylinders, which drum driving mechanism comprises means for varying such reduced speed.

15. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper surface finished by the cylinders is brought and means for rotatively driving the drums.

16. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, a set of calender rolls and rotative drier drums forwardly beyond the finishing cylinders and to the action of both of which the paper surface finished by the cylinders is brought and means for rotatively driving the calender rolls and drier drums.
faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, and rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper, surface finished by such cylinders, is brought, and mechanism for rotatively driving the drier drums at lessened surface speed than that of the cylinders.

18. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, rotative drier drums forwardly beyond the finishing cylinders and to the action of which the paper, surface finished by such cylinders, is brought, and mechanism for rotatively driving the drier drums at lessened surface speed than that of the cylinders, which mechanism comprises means for varying the reduction of the speed.

19. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, said cylinders being provided with gear wheels in mesh with each other and means for driving the gear train, a shaft having a cone pulley thereon, and a gear wheel in mesh with one of the cylinders, and a shaft having driving connection therewith and provided with a cone pulley and an endless belt in running engagement around said cone pulleys.

20. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, said cylinders being provided with gear wheels in mesh with each other and means for driving the gear train, a set of calendars and a rotary drier drum forward of the cylinders, a shaft gear-connected with one of the cylinder gears, and means operated by said shaft for driving the calendars, another shaft having a cone pulley thereon and a gear wheel in mesh with one of the cylinder gears, a still further shaft in driving connection with the drier drum and having a cone pulley thereon, and an endless belt around the cone pulleys.

21. In a surface finishing machine for paper, a plurality of sets of rotative cylinders, each set comprising in its perimeter cooperative peripheral surface-finishing faces and circumferentially reduced and non-coacting portions, the cylinders of one set having their cooperative peripheral faces all at the same sides of such cylinders while the cooperative faces of the cylinders of the other set are in a reversed relation to the corresponding faces of the cylinders of the first set, said cylinders being provided with gear wheels in mesh with each other and means for driving the gear train, a shaft having a cone pulley thereon, and a gear wheel in mesh with one of the cylinder gears, a support for a moist upper web roll at the rear of the cylinders, a rotary drier drum forward of the cylinders, and a shaft having driving connection therewith and provided with a cone pulley and an endless belt in running engagement around said cone pulleys.

Signed by me at Springfield, Mass, in presence of two subscribing witnesses.

HENRY P. HOWE.

Witnesses:

G. R. DRISCOLL,
RICHARD S. BELLOWS.