

July 8, 1941.

J. E. BURBANK

2,248,333

WEB TREATING APPARATUS

Filed Sept. 20, 1939

2 Sheets-Sheet 1

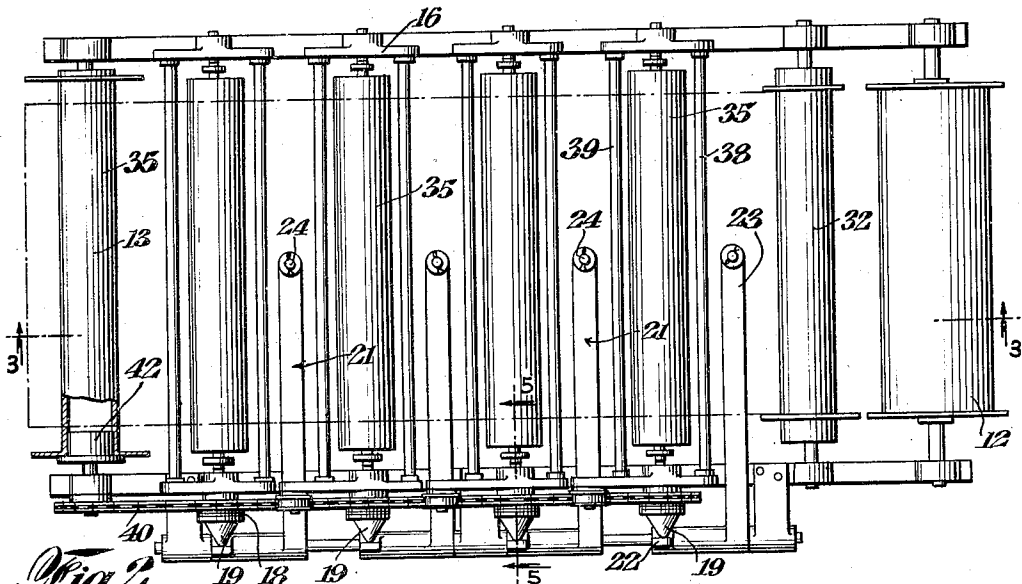


Fig. 2.

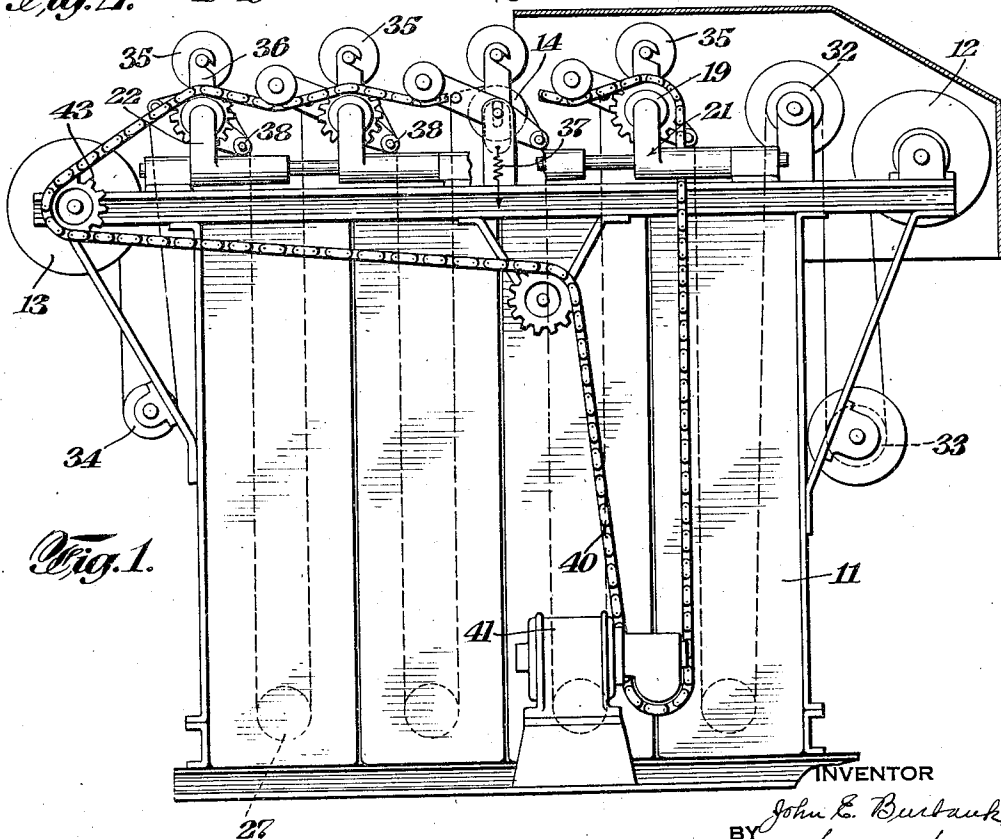


Fig. 1.

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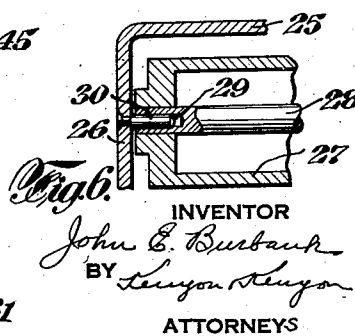
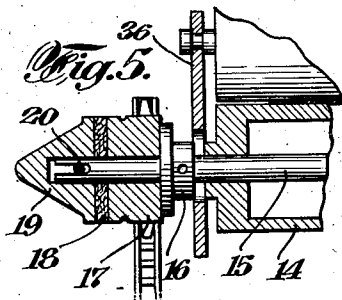
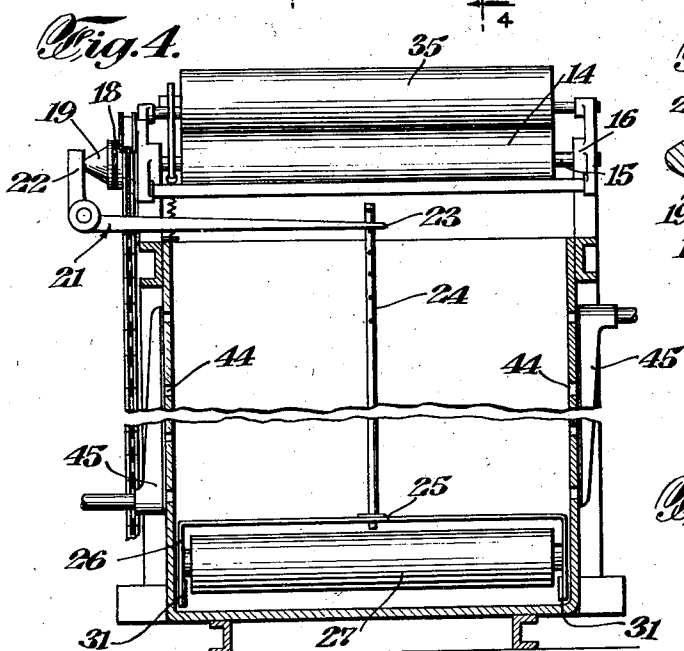
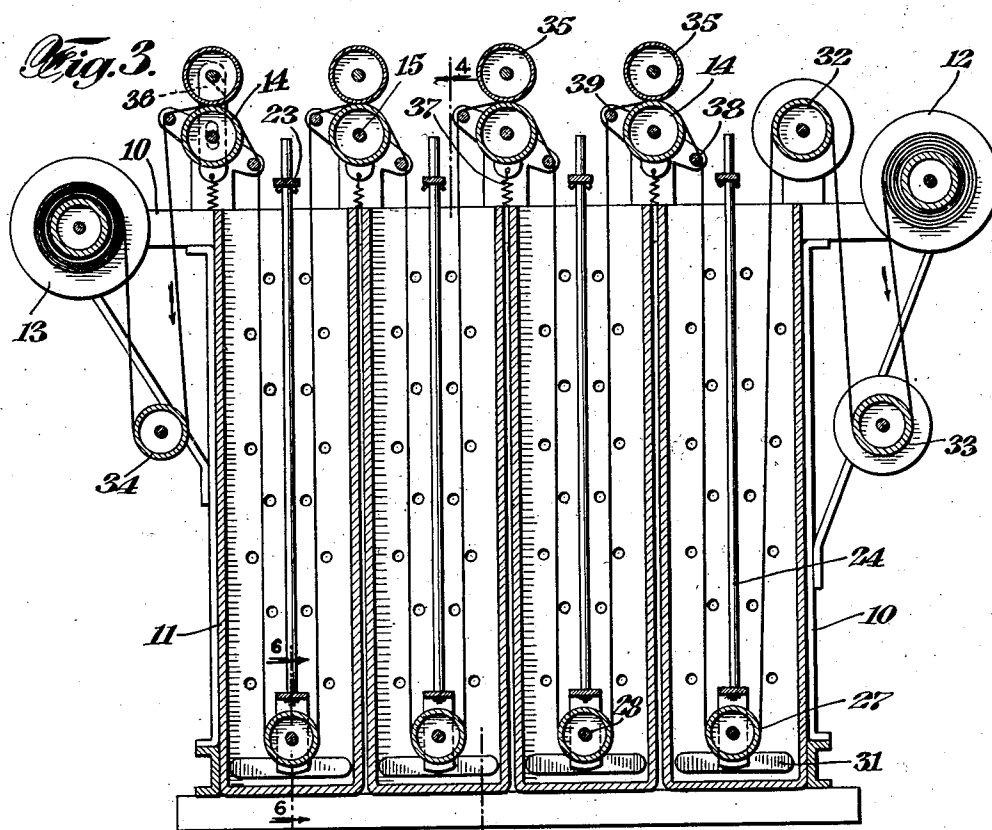
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,248,333

WEB TREATING APPARATUS

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Application September 20, 1939, Serial No. 295,705

23 Claims. (Cl. 95—94)

This invention relates to web treating apparatus and more particularly to apparatus for subjecting a strip of exposed photographic paper to a series of developing treatments with different liquids followed by washing and drying operations.

A machine for this purpose comprises a plurality of tanks or chambers through which the paper is passed in succession and such tanks or chambers contain different liquids or are equipped with drying means. Means, preferably rollers, are provided for conveying the paper into and out of the tanks and with each roller over which the paper passes on leaving a tank is preferably provided a co-operating or squeegee roller for wringing liquid out of the strip to return such liquid into said tank. The paper, upon entrance into the first tank is wetted and is materially reduced in tensile strength as well as subjected to longitudinal expansion. Due to its reduced tensile strength, it cannot stand the tension which would be required to pull it through a pair of rollers and for this reason driving means are provided for each pair of rollers to effect feeding of the strip through the tank with which such pair of rollers is associated. In the succeeding tanks or chambers, the paper may undergo further expansion or shrinkage thereby varying the speed of rotation required for each pair of rollers to advance the strip of paper uniformly through the successive tanks. Any excessive tension on the paper while wet is the direct cause of wrinkles and so the maximum tension on the weakest paper must never be greater than the amount which will handle it without any trace of wrinkles and while this paper tension never can be exceeded, there must always be enough power at the rollers to pull the heaviest paper through the apparatus. Also, a very uniform tension must be kept on the paper to minimize development of wrinkles or lateral shifting of the paper, particularly while it is entering the first tank, as it has a tendency to expand unevenly when it is allowed to fall loosely into the tank and such uneven expansion will cause lateral displacement of the paper on its conveying rollers with resulting damaged edges. The squeegee rollers constitute a drag on the paper, varying for different papers, and also hinder the passage of splices which very frequently occur in the paper. In order to avoid rupture of the paper strip when a splice is presented to the squeegee rollers, such rollers must be supplied with momentary extra force to effect passage of the splice therethrough. Also, the rollers

must be automatically supplied with the proper amount of power required for feeding different types of paper.

An object of this invention is an apparatus of the character above described which feeds the paper strip through a succession of tanks while maintaining proper tension at all times on the successive sections of the strip, supplies additional power to the rollers without any increase of tension on the paper, minimizes contamination of the solution in one tank by solution in the preceding tank, is able to handle different papers having different rates of expansion or contraction and to supply the power requirements of different papers, requires minimum time and labor for starting and operates efficiently without requiring any particular attention.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a side elevation of a machine embodying the invention;

Fig. 2 is a plan view thereof;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 2, and

Fig. 6 is a section on the line 6—6 of Fig. 3.

In a frame 10 are contained several tanks 11, each of which is substantially rectangular in cross-section and of considerable depth. A supply reel 12 is provided at one end of the frame and a take-up reel 13 is provided at the other end of the frame. A plurality of web-feeding rollers 14 are supported by shafts 15 journaled in uprights 16 carried by the frame 10, each roller being substantially directly above one wall of a tank 11. On each shaft 15 is rotatably mounted a sprocket-equipped hub 17, to the outer face of which is attached a disk 18 of friction material. A cap 19 is slidably keyed to each shaft 15 by a pin 20 for movement into and out of engagement with the friction disk 18.

For each cap 19 there is provided a bell crank lever 21 supported by the frame 10 and having a short arm 22 engaging the end of the cap 19. The lever also has a long arm 23 arranged substantially midway of two sides of each tank 11 and terminating centrally thereof. A rod 24 is loosely connected at its upper end to the end of the arm 23 so as to be capable of slight movement relative to the sides of the tank and at its lower end is loosely connected to a bracket 25 having ears 26. A guide roller 27 is journaled

in the ears 26 and the point of attachment of the rod 24 to the bracket 25 is substantially midway of the roller 27, so that a slight tilting of the roller 27 is permitted. Each roller 27 is rotatably supported by a shaft 28 having a socket 29 at each end into which projects a pin 30 supported by an ear 26. The roller 27 is rotatable about the shaft 28 which in turn is rotatable with respect to the pin 30. A bar 31 is attached to each ear 26 and is of sufficient length to prevent any substantial transverse movement of the roller 27. The increase and decrease in the film loop causes movement of the roller 27 and its supporting parts to vary the position of the cap 19 thereby varying the friction between it and the hub 17 with consequent regulation of the driving force supplied to the roller 14.

The arrangement of the tanks 11 is such that each roller 14 constitutes a guide for a web entering or leaving a tank and an additional roller 32 is provided as a guide for the web entering the first tank. Also, tension rollers 33 and 34 are provided at the entrance and exit ends, these rollers being supported for slight vertical movement and also being free to teeter slightly. The web passes from the supply reel 12 under the roller 33, over the roller 32, under the roller 27 in the first tank, over the first roller 14, and so on through the remaining tanks and from the last roller 14 under the roller 34 and to the take-up reel 13. A squeegee roller 35 is associated with each roller 14 and is journaled in straps 36 having slots through which extends the shaft 15. A spring 37 pulls each strap 36 downwardly to urge the roller 35 into contact with the roller 14 to squeeze the web.

Associated with each roller 14 is a pair of guide rollers 38 and 39 which guide the web to and from the roller 14. The roller 38 is provided for the purpose of removing longitudinal wrinkles in the web before it passes to the feeding roller 14. Each roller 38 is so positioned relative to the roller 14 that it effects a change of at least 20° in the direction of travel of the web and its radius is not over 40 times the thickness of the web. With such dimensions and arrangement, the roller 38 is effective to remove longitudinal wrinkles from the web. The roller 39 is provided for stripping the web from the roller 14. Without a guide such as 39, the web would tend to stick to the roller 14 and wind around it should there be any slack in the web. In order to avoid having the web stick to the roller 39, such roller is of such size that its radius is not over 40 times the thickness of the web.

The successive tanks contain treating fluids of different types which have different effects upon the webs or constitute drying chambers. The web, upon entrance into the solution in the first tank undergoes substantial longitudinal expansion by reason of being wetted and also is materially reduced in tensile strength for the same reason. In the succeeding tanks, the action of the treatment therein may result in further longitudinal expansion of the web or may result in longitudinal contraction thereof. The passage of the web through each tank is effected by the pull applied thereto by the roller over which the web passes upon emergence from said tank so that the web does not in any case have to transmit power more than enough to overcome the fluid resistance to motion which is obviously very slight. Under no conditions does the web supply any motive power for any set of squeegee rollers.

The rollers 14 are all of the same size, but the sprocket wheel for the first roller 14 is larger than the remaining sprockets. A driving chain 40 passes around all the sprockets and a sprocket operated by the driving motor 41. The take-up reel 13 is frictionally supported by a pair of hubs 42 to one of which is attached a sprocket 43 also driven by the chain 40. As the sprocket of the first roller 14 is larger than the remaining sprockets, the peripheral speed of the first roller is less than that of the remaining rollers whenever all the clutches are fully effective, so that additional expansion in succeeding tanks may readily be compensated.

The weight of the reel 12 and the web carried thereby is sufficient to produce tension on the web between the roller 32 and the roller 14 of the first tank tending to lift the roller 27. Such tension varies as the amount of web on the roller decreases but at all times such tension lies within a definite range. In the succeeding tanks, tension on the web is caused by the relative feeding rates of the successive rollers 14. The lifting force of the web on the roller 27 is double the tension on the web and when such lifting force exactly equals the combined weight of the roller 27 and its supporting mechanism, the roller 27 is maintained at constant elevation with the cap 19 in a fixed position relative to the friction disk 18 and power is supplied to the roller at a fixed rate. However, should there be any variation in the lifting effect of the web due to any cause such, for example, as a change in the expansion rate of the web in the tank, or stoppage of the web fed due to the contact of a web splice with the nip of the rollers 14 and 35, there will be a corresponding actuation of the cap 19 to vary the power supplied to the roller 14 to compensate the lifting effect variation. The weight of the rollers 27 and their supporting means and the drag exerted by the reel 12, is such that the proper tension is produced in the web sections in the various tanks to maintain the web free of wrinkles and taut without subjecting it to excessive strain.

Means are provided for circulating fluid in the tanks transverse of the direction of feed of the web. For this purpose, apertures 44 are provided in the end walls of each tank in combination with discharge and exhaust headers 45.

The arrangement is such that the feeding rollers automatically become inoperative in the event that entrance of the web into the first tank is prevented. Under such circumstances, the various guide rollers 27 would be successively lifted thereby successively disengaging the clutches for the feeding rollers 14. Such rollers would automatically come to a stop and the feeding of the web would cease, thereby avoiding the possibility of any injury to the web. It is thus seen that the apparatus has a self-stopping feature.

I claim:

1. A machine for subjecting a web to a succession of treatments with liquids comprising a series of liquid-containing tanks through which the web passes successively in down and up vertical runs, a feeding roller for each tank over which the web passes upon emergence from said tank, a pressure roller co-operating with each feeding roller to remove liquid from said web, driving means individual to each feeding roller consisting of a rotatable member having variable frictional engagement with said roller, means for rotating said rotatable members at constant

speed, and means including a web-actuated element adjacent the bottom of each tank for inversely varying the driving friction exerted upon any feeding roller in response to tension variation in the section of the web in the tank with which said feeding roller is associated.

2. A machine according to claim 1 characterized by the first of said feeding rollers having its maximum peripheral speed less than the maximum peripheral speed of the remaining feed rollers.

3. A machine according to claim 1 characterized by the feeding rollers being of equal size and the rotational speed of the driving member for the first roller being less than that of any of the other driving members.

4. A machine for subjecting a web to a succession of treatments with liquids comprising a series of liquid-containing tanks through which the web passes successively in down and up vertical runs, a feeding roller for each tank over which the web passes upon emergence from said tank, a pressure roller co-operating with each feeding roller to remove liquid from said web, a rotatable driving member for each feeding roller, means for rotating said rotatable members at constant speed, a friction clutch between each rotatable member and its associated feeding roller, a guide roller adjacent the bottom of each tank substantially parallel to the feeding roller and under which the web passes, connections between said guide roller and friction clutch for increasing the driving friction exerted upon the feeding roller upon downward movement of said guide roller and releasing such driving friction upon upward movement of said guide roller.

5. A machine for subjecting a web to a succession of treatments comprising a series of tanks through which the web passes successively, a feeding roller for each tank over which the web is passed upon emergence from said tank, a pressure roller associated with each feeding roller, a rotatable driving member for each feeding roller, means for rotating said rotatable members at constant speed, a friction clutch between each rotatable member and the associated feeding roller, a guide roller in each tank substantially parallel to said feeding roller and under which the web passes, a rod supporting said roller for limited tilting movement, a pivoted lever having one end loosely connected to said rod and its other end operatively related to said friction clutch for increasing the driving friction exerted upon the feeding roller upon downward movement of said guide roller and releasing such driving friction upon upward movement of said guide roller.

6. A machine according to claim 1 characterized by means for limiting transverse movement of each guide roller in its tank.

7. A machine for subjecting a web to a succession of treatments comprising a series of tanks through which the web passes successively, a feeding roller for each tank over which the web is passed upon emergence from said tank, a pressure roller associated with each feeding roller, a rotatable driving member for each feeding roller, means for rotating said rotatable members at constant speed, a friction clutch between each rotatable member and the associated feeding roller, a guide roller in each tank substantially parallel to said feeding roller and under which the web passes, a bracket having portions in which are journaled the ends of said guide roller, a rod having one end loosely connected to said bracket

centrally of said guide roller, and a pivoted lever having one end loosely connected to said rod and its other end operatively associated with said friction clutch for increasing the driving friction exerted on said feeding roller upon downward movement of said guide roller and releasing such driving friction upon upward movement of said guide roller.

8. A machine for subjecting a web to a succession of treatments comprising a series of tanks through which the web passes successively, a feeding roller for each tank over which the web passes upon emergence from said tank, a pressure roller associated with each feeding roller, a first clutch member for each roller coaxial therewith and rotatable relative thereto, means for rotating said first clutch members at constant speed, a second clutch member for each roller slidably keyed thereto for frictional contact with the first clutch member, a guide roller in each tank substantially parallel to the feeding roller and under which said web passes, a rod supporting said guide roller for limited operating movement, and a pivoted lever having one end loosely connected to said rod and its other end connected to said clutch member for increasing the friction between said clutch members upon downward movement of said guide roller and releasing such friction upon upward movement of said guide roller.

9. A machine for subjecting a web to a succession of treatments comprising a series of tanks through which the web passes successively, a feeding roller for each tank over which the web passes upon emergence from said tank, a pressure roller associated with each feeding roller, a first clutch member for each roller coaxial therewith and rotatable relative thereto, means for rotating said first clutch members at constant speed, a second clutch member for each roller slidably keyed thereto for frictional contact with the first clutch member, a guide roller in each tank substantially parallel to the feeding roller and under which said web passes, a bracket having portions in which are journaled the ends of said roller, a rod having one end loosely connected to said bracket centrally of said roller, a pivoted lever having one end loosely connected to said rod and its other end connected to said second clutch member for increasing the friction between said clutch members upon downward movement of said guide roller and releasing such friction upon upward movement of said guide rod.

10. A machine according to claim 1 characterized by a roller before and after each feeding roller arranged to guide the web to and from said feeding roller, each of said rollers having a radius not exceeding 40 times the web thickness and the roller ahead of the feeding roller being arranged to change the direction of web travel at least 20°.

11. A machine according to claim 4 characterized by a roller before and after each feeding roller arranged to guide the web to and from said feeding roller, each of said rollers having a radius not exceeding 40 times the web thickness and the roller ahead of the feeding roller being arranged to change the direction of web travel at least 20°.

12. A machine according to claim 5 characterized by a roller before and after each feeding roller arranged to guide the web to and from said feeding roller, each of said rollers having a radius not exceeding 40 times the web thickness and the roller ahead of the feeding roller being

arranged to change the direction of web travel at least 20°.

13. A machine according to claim 4 characterized by the first of said feeding rollers having its maximum peripheral speed less than the maximum peripheral speed of the remaining rolls.

14. A machine according to claim 5 characterized by the first of said feeding rollers having its maximum peripheral speed less than the maximum peripheral speed of the remaining rolls.

15. A machine according to claim 9 characterized by the first of said feeding rollers having its maximum peripheral speed less than the maximum peripheral speed of the remaining rolls.

16. A machine according to claim 4 characterized by means for limiting transverse movement of each guide roller in its tank.

17. A machine according to claim 5 characterized by means for limiting transverse movement of each guide roller in its tank.

18. A machine according to claim 7 characterized by means for limiting transverse movement of each guide roller in its tank.

19. A machine according to claim 4 characterized by the feeding rollers being of equal size and the rotational speed of the driving member for the first roller being less than that of any of the other driving members.

20. A machine according to claim 9 characterized by the feeding rollers being of equal size and the rotational speed of the driving member for the first roller being less than that of any of the other driving members.

21. A machine for subjecting a web to a succession of treatments with liquids comprising a series of liquid containing tanks through which the web passes successively in down and up vertical runs, a feeding roller for each tank over which the web passes upon emergence from said tank, a pressure roller co-operating with each feeding roller to remove liquid from said web, driving means individual to each feeding roller consisting of a rotatable member having variable frictional engagement with said roller, means for rotating said rotatable members at constant speed, and means including a web-operated member adjacent the bottom of each tank for actuating one of said rotatable members to vary its frictional engagement with its associated roller, said means being operable by said web for moving said member to increase the driving friction exerted upon the feeding roller in response to tension decrease in the section of the web in the tank with which the feeding roller is associated and to decrease said driving friction upon tension increase.

22. A machine according to claim 21 characterized by the first of said feeding rollers having its maximum peripheral speed less than the maximum peripheral speed of the remaining feed rollers.

23. A machine according to claim 21 characterized by the feeding rollers being of equal size and the rotational speed of the driving member for the first roller being less than that of any of the other driving members.

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