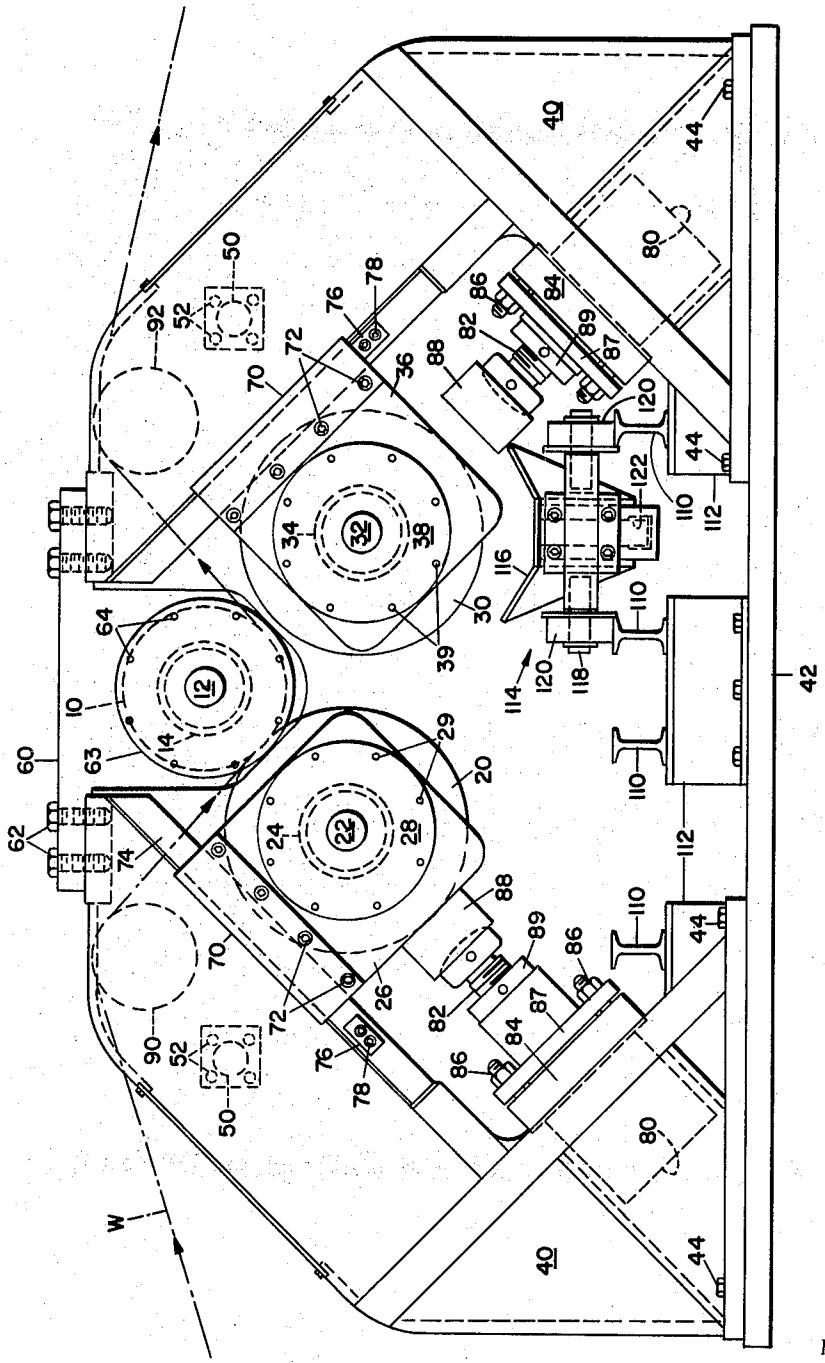
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CALENDER

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CALENDER

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This invention relates to structural refinements in roller equipment of the type used in the manufacture of sheet material such as paper or textiles and has special reference to calender apparatus of improved construction.

Conceivably, the principles of the invention have other applications, as for instance in the case of compression rolls used in the cloth finishing process known as fulling and washing in the textile art. In such process, just as in paper calendering and/or in many other applications where this invention will have utility, it is normally necessary or desirable to subject the work material to pressures of high magnitude in order to perform various operations thereupon, such as the removal of moisture, reduction of thickness, treatment of the surface, and the like, by passing the work material between large cylindrical rolls disposed in sets or stacks called calendering units. In one form of such unit, it is known to mount one roll of an opposed pair, or more than one roll of a series, in yielding relation to an opposing roll or rolls, and for a multiplicity of valid reasons including to prevent the exertion of excessive pressure as varying thicknesses of the work material being compressed are passed therebetween. Resort has commonly been had to the use of spring loading or similar devices to load the yieldably mounted roll.

The invention hereof advantageously exploits this yielding relationship of opposed rolls to teach a method of replacing a roll without a stoppage of the machine employing same.

According to the known prior art, transversely-spaced calender side frames have vertically-disposed slots for the reception of bearings, in which bearings, the opposite ends of the rolls are journalled. For aiding roll removal, sides of the side frames are cut away to provide openings into the slots, and cheeks are fitted in such openings and are removably secured therein. To remove a roll, the cheeks are removed from the openings, wherefor the roll ends and bearings may be withdrawn outwardly. Reversely, installing a roll, the roll ends and bearings are passed inwardly through the openings, and the cheeks are then secured in situ. Such practice is expensive, and furthermore, the removal of a roll from, and the insertion thereof into, the side frames is a laborious operation and presents the objectionable problem of excessive downtime of the calender. Too, the fitting of the cheeks in the side frames requires extreme accuracy and entails great expense. Various other means have been employed to permit easy removal of a calender roll when desired, but prior to this invention, the normal practices require the stopping of the calender and the calendering process to permit disconnection of the roll and its accessories prior to removal of the roll from the stack. This has resulted in lost production time or the manufacture of unsaleable material which has had to be reprocessed.

According to known methods of manufacturing paper and paper board, the material is conventionally run through the papermaking machine, wound upon rolls, transferred to a calender, unwound for feeding through the calender, so fed therethrough, and again rewound upon other rolls, all with certain quanta of time lost and material wasted each time the paper or paper board is wound or unwound. Until now, it has not been practical to run material through a papermaking machine and thence directly into a finishing calender, and all for the

recognizable reason that the papermaking machine, once started, can not easily be stopped for any changing of a damaged calender roll, roll damage being a never-ending problem in apparatus of the type here envisioned. For instance, in operation, pieces of paper or foreign matter frequently stick to a roll only to be carried around through the opposed nips to cause damage to the surface of adjacent fiber or paper rolls by producing surface irregularities. Sometimes such material is transferred to second and third rolls and thus damaging further rolls. This effect is also frequently produced by a break in the sheet while pressure is being exerted upon the rolls so as to induce spots or streaks in the sheet necessitating the grinding down or otherwise treating of the surface of the roll so as to remove the surface irregularities.

As will be readily appreciated, a papermaking machine, once rendered operational, must run continuously; any interruption in such operation would result in the pileup of wasted material while any roll replacement in the finishing calender is being effected.

Basically, the invention envisioned is illustrated by an embodiment including a stationary hardened roll and a pair of movable pressure rolls with cooperant means for moving the movable pressure rolls of the pair into and out of contact with the stationary roll in seriatim and selectively, as circumstances may dictate.

Furthermore, I have aimed as an object of this invention to provide improved means whereby to allow calendering directly on the papermaking machine by offering an ability to replace a damaged or marked roll of the unitized calender without machine stoppage, and additionally, without interruption of the passage of the paper web through the calender.

Another of the objects of this invention is to provided means for quickly applying or relieving the pressure or force urging either or both lower filled rolls upwardly toward the upper roll with means for independently controlling the loading on the filled rolls so that either or both rolls may be in open or closed nip positions.

A further object is to provide a mounting for a lower roll which permits the same to be quickly shifted away from operative position in confrontation with the upper hardened roll to permit the free passage of material between the rolls without damage to either thereof and by means of which the lower roll can be quickly restored to its operative position, all while the rolls are rotating.

As another object, I provide means for moving apart the rolls such a distance as will provide a sufficient access space to allow the making of repairs in situ, the threading of the material, and the inspecting of the equipment so as to determine if removal is indicated.

Also provided is an off-nip drive which constantly rotates the filled rolls in open nip position to prevent burning of the filling and accelerates the filled roll to substantially the same surface speed as the steel roll prior to the nip being closed, and after the steel and filled rolls are in contact this drive will be automatically declutched or over run.

In the drawing, the figure is a view, in side elevation, a calender comprising an upper calender roll and a pair of lower calendar rolls and provided with means embodying the invention whereby one or the other of the lower calender rolls may be quickly withdrawn from operating position in confrontation with the upper calender roll for repair or replacement purposes and eventual quick and easy restoration to its said operating position, whereby this withdrawing and replacement may be accomplished without reducing the operating speed of the calender and without breaking the web of material passing through the calender.

In explaining the invention, a calender is shown as

embodying a stack of three triangularly-related rolls, an uppermost stationary or fixed roll **10** adapted to cooperate with one or the other of a pair of lowermost adjustable and removable resilient pressure rolls **20** and **30**. It will be understood, however, that a calender may include any desired number of rolls and the novel features of the invention may pertain to any plurality thereof.

Referring now to the drawing more in detail, the novel features of the invention will be described.

The three-roll calender includes an upper stationary or fixed top calender roll **10**, as aforesaid, which roll may be formed of steel (hardened or soft), chill iron or other suitable metal with or without a hardened and ground or polished or even engraved roll face. Said roll may be cooled or may be heated as by electricity, hot oil, steam or like means and may incorporate automatic temperature control devices. Top roll **10** may be mounted upon or unitary with a top roll shaft **12** which is mounted in the usual oppositely-disposed roller bearings or other suitable anti-friction means supported in appropriate bearing housing, all as will appear.

The lower rolls **20** and **30** may be filled rolls filled with a non-metallic material, as for instance cotton, held on steel shafts **22** and **32** respectively under endwise pressure induced by end members which are locked to the respective shafts. The shafts may be bored for heating or cooling purposes.

The roll shafts extend beyond the opposite ends of the respective rolls and these shafts are rotatably mounted in bearing housings for support relative to suitable frames at opposite sides of the calender.

Each frame, preferentially though not obligatorily, will be made of heavy-welded, stressed-relieved, steel construction and will be of generally triangular configuration formed by a pair of horizontally-spaced vertically-disposed uprights **40** upstanding from and secured to a base plate **42** or foundation as by bolting **44**, and generally angularly-inclined as to each other so as to converge toward each other at the triangle apex in manner to allow a relatively narrow vertically-disposed operating area therebetween at their upper portions and further to allow a relatively wide operating area therebetween below the said upper portions.

The opposite frames are held in transversely-spaced relation as to each other as by tie means in the form of tie rods **50** of conventional style, each tie rod being secured to the upright of one frame into its counterpart upright of the other frame as by suitable bolting **52**, all whereby the said frames are suitably spaced as to each other for disposition at opposite ends of the rolls which they support.

A top or stationary roll support plate **60** is fixedly mounted on top of uprights **40**, **40** of each frame of the pair thereof as by suitable bolting **62** so as to interconnect the uprights and to depend downwardly through the provided relatively narrow operating area therebetween in manner to extend therethrough and to terminate within the provided relatively wide operating area therebelow.

Top roll shaft **12** for top or stationary roll **10** is journalled in suitable bearings **14**, as for example roller bearings, mounted in the adjacent of the top roll support plates **60** at each end of the roll, each bearing being held in its respective support plate **60** as by an outer end plate **63** secured to the support plate **60** as by bolts or screws **64**, all thereby to hold the ends of the shaft against axial movement relative to support plates **60**, **60** and to retain a lubricant for the bearing. Cooled, filtered, oil may be circulated therethrough to provide ample lubrication and cooling for the bearings.

By such means, the steel or iron calender roll **10** is fixed in its location respective to the frames of the pair and is, in effect, anchored to the sides of the frame.

The opposite ends of the two lower roll shafts **22** and **32** for the lower pressure rolls **20** and **30** respectively are each journalled in suitable bearings **24** and **34** respectively, as for example roller bearings, suitably mounted in the adjacent trunnion or bearing housing or block **26** and **36** respectively at each end of the respective roll. Each such bearing is held in its respective bearing housing as by an outer end plate **28** or **38** secured to the respective bearing housing **26** or **36** as by bolts or screws **29** or **39**, thereby to hold the ends of the respective shaft against axial movement relative to its trunnions or bearing housings and to retain a lubricant for the bearing. Cooled oil may be circulated therethrough.

In the case of each bearing housing **26** and **36**, a removable gib **70** is fixed thereto as by suitable bolting **72** to provide a guideway to seat on an elongated machined way **74** secured to the inwardly-extending face of the respective upright **40** of the frame by any suitable means, the bearing housing being slidably adjustable lengthwise of its respective way. The removable gibs allow the easy removal of the rolls from the frames.

Thus it will be seen that the sides of the frame have machined ways on which the filled rolls may slide, one roll on each leg of the provided triangular arrangement.

A limit stop **76**, fixedly secured to each way **74** as by bolting **78** serves to limit the withdrawal or downward movement of the respective bearing housing along its upright and way thereof.

Roll shafts **12**, **22** and **32** preferentially are formed of forged steel and may be bored therethrough for purposes of receiving water or air or other cooling or heating medium therethrough.

One outer extremity of shaft **12** of top roll **10** may be extended in manner to accept a drive from a suitable main power means (not shown) such as for example a motor directly connected or gear driven or connected by a roller chain, V-belt or timing belt to an appropriate sprocket on the shaft and means may be provided to synchronize the roll drive with any other machine or machines in the line.

One outer extremity of each of the shafts **22**, **32** of lower rolls **20**, **30** respectively may be extended in manner to accept a drive from such as an off-nip, variable speed, drive motor (not shown) functioning to slowly rotate its respective roll when the nip is open and to accelerate its respective roll to operating speed when and as the nip is being closed, it being of course understood that top roll **10** and lower rolls **20** and **30** are driven in directions to advance the material to be passed through the calender from one end thereof to the other.

An over-riding or declutching means may be provided for the off-nip drive motor to ensure that the top roll drives the filled roll when they are in contact without any hindrance from the off-nip drive motor.

If desired, the opposite extremity of top roll **10** may be extended for the accommodation of slip rings, connecting gears, heating and cooling connections, and like contrivances.

The bearing housings for the lower filled rolls are motivated upwardly toward the top roll by any usual or suitable hydraulic or power actuated mechanisms **80** or cylinder motors, each of which includes a ram or piston or plunger **82** arranged in the upper bore of a ram cylinder housing **84**, which mechanisms are each located in the base of their respective upright. Screws **86** hold seal cover plates **87** of the ram cylinder housing.

Piston caps **88** are suitably mounted upon the outer free ends of the rams or pistons or plungers **82**. Cylinder housing **84** is closed at its upper end by a removable closure member or cap **89**. Fluid under pressure may pass in known manner to and from the lower portion of the cylinder housing through a suitable pipe or duct (not shown) for urging the piston **82** against and away from the respective bearing housing, in directions parallel to the machined ways, whereby to exert force against the respective bearing housing, the opposite pis-

tons at the opposite ends of a lower roll acting unisonly to drive the respective bearing housings toward and away from the top roll so as to force the respective lower roll toward and away from the top roll. That is, when pressure is applied, the pistons move parallel to their respective ways and exert a loading on the bottom of the filled roll bearing housings to close the nip.

The system is such as to permit independent loading of each hydraulic or power actuated mechanism or cylinder motor.

Screw jacks may be provided on each mechanism to allow the attainment of fine adjustment of nip closing and further to allow for changes in the diameter of the filled roll.

Each piston exerts a yielding pressure against its respective bearing housing, and cooperantly, the pistons force the lower roll upwardly against the top roll or into contact with a web of sheet material W which is pressed between the rolls.

When fluid under pressure is supplied to the cylinder housings, the pistons thereof will move upwardly, for example into the position shown on the left side in the figure and causing the slidable cylinders and the hydraulic piston caps to move upwardly a corresponding extent.

Generally, the upward movement required to motivate the lower roll into pressing relationship with the top roll is not very great, one quarter inch upward movement, for example, being generally sufficient for such purpose. The extent of this movement may vary considerably, however, depending on the size of the calender and other factors. Greater upward movement is desirable in this instance to present a sufficient amount of space for the convenient removal of a filled roll with its bearings and housings.

A guide roll **90**, suitably journalled between the pair of transversely-spaced uprights at the leading side of the calender serves for the entrainment of web W therearound before its passage around top roll **10** and a guide roll **92**, suitably journalled between the pair of transversely-spaced uprights at the trailing side of the calender, serves for the entrainment of web W therearound following passage of the web around top roll **10**.

In the construction shown, it is assumed that the material W to be calendered enters from the left of the figure over guide roll **90** and into the bight between top roll **10** and lower roll **20**.

In vertically-aligned position below each of the lower rolls **20** and **30**, a pair of spaced transversely-extending roll carriage tracks or rails **110** are provided, same being fixedly mounted upon suitable tie members **112** stationarily secured to the frames or foundation at opposite sides of the apparatus as shown. Alternatively, such tracks or rails could be machined in the base.

Each pair of tracks or rails supports a wheeled roll carriage, indicated generally by **114**, and constituted by a welded steel cradle or roll-supporting chassis **116** mounted on a pair of spaced axles **118**, each of said axles mounting at each of its opposite ends a flanged wheel **120** in known manner.

Additionally, each wheeled roll carriage **114** will incorporate a manually operated hydraulic lift **122** or a pair thereof for effecting the raising and lowering of the cradle relative to the wheels thereby to effect lifting of a new or repaired roll into position for attachment to the frames, to support a damaged roll while removing the gibs, and/or to lower a damaged roll to a convenient level for removal from the frames.

A shut-off valve (not shown) may be placed in the hydraulic circuit so that the cradle height may be maintained at any desired level.

In the operating sequence, the main drive motor is started to rotate top roll **10** at a slow threading speed and the off-nip drives are started for rotating the lower filled rolls. Pressure is then applied to the hydraulic cylinders serving filled roll **20** to effect a closing of the nip between top roll **10** and filled roll **20**, the off-nip drive of roll **20** accelerating the said roll to threading speed as the nip closes. The web of material is then threaded through the calender. Pressure is applied to the desired loading to the hydraulic power control means of filled roll **20**. The operating speed is then accelerated to normal and the machine is fully operative.

Through operational use, filled roll **20** may become damaged from marking, burning, dirt or other causes. When desired to substitute the filled rolls, pressure is applied to filled roll **30** so as to close the nip between it and top roll **10**, all without any stopping or retarding the speed of the calender. The off-nip drive of filled roll **30** accelerates the said roll to operating speed before the nip closes, an over-riding clutch disconnecting the off-nip drive motor just before closing of the nip. Hydraulic pressure is increased to the operating level. When filled roll **30** is satisfactorily operational, the pressure on filled roll **20** is released to permit the nip thereof to open and the roll to descend to the limit stops.

The roll carriage is moved into position under filled roll **20** from the side of the calender opposite the main drive. The operator manually actuates the hydraulic lift to raise the cradle to the point where the roll bears thereupon and the weight thereof is supported thereby. The gibs for filled roll **20** are removed. Pressure on the hydraulic lift is gradually released until the roll and carriage reach lowered positions at a height convenient for the removal of the roll from the frames. All auxiliary piping and wiring are disconnected from filled roll **20**, and the roll and its bearings and housings are then removed through the frame on the side opposite the drive. Meanwhile filled roll **30** continues to process the material until it is damaged, when a new filled roll **20** can be installed.

To install a new or repaired filled roll in the filled roll **20**, the above procedure is reversed. When the replaced filled roll is mounted on the frames, the off-nip drive motor is started to keep the roll rotating at slow speed to prevent any excessive heat from burning a local spot on the filling and to equalize any sag in the roll due to its own weight.

Thus, when filled roll **30** is ready for replacement, filled roll **20** is in the frames ready to be moved into position for closing the nip, and filled roll **30** may be removed in a manner similar to that used for filled roll **20**.

All drives are arranged so the gib bolts are accessible while the calender is operating, and all connections and disconnections to the filled rolls can be made without disturbing the web or reducing the speed of the calender.

Such on-machine calender will be seen to make it possible to exchange or replace the filled roll of various types of calenders without breaking the web or reducing the speed of the machine. Utilizing this or similar designs, it is possible for a paper manufacturer to have a continuous web of material from the beginning of the paper-making machine to the end of the final finishing calender. The possible economies from this type of operation are large and obvious, no losses from unwind and rewind operations, less handling at intermediate stages, no lost production time while changing filled rolls, less equipment required, less personnel, less power required, to mention but a few.

I therefore particularly point out and distinctly claim as my invention:

1. A three-roll calender comprising, a pair of spaced frames, an upper stationary roll and two lower filled rolls provided with roll shafts extending beyond the ends thereof with the axes of the roll shafts being disposed in triangular arrangement, bearings for said roll shafts mounted relative to said frames of said pair thereof and cooperating with the end portions of said roll shafts, housings on which said bearings are supported, ways on said frames of said pair thereof in which said housings are releasably and slideably mounted to permit said lower

rolls to move in seriatim and selectively toward and from said upper roll, means located below and acting on said housings of said lower rolls for urging said lower rolls upwardly toward and downwardly away from said upper roll, a roll carriage between said frames located below and vertically alignable with each said lower roll, means for selectively raising and lowering said roll carriage whereby said carriage may be moved into and out of supporting engagement with one of said rolls to selectively permit the removal of said roll housings and said one of said rolls from the frames and the engagement of said roll housings and said one of said rolls with said frames, said frames being so spaced as to permit the removal of said carriage from its position therebetween.

2. A three-roll calender as set forth in claim 1 including pairs of tracks disposed below and vertically aligned with said lower rolls, said carriage being rollable along said tracks.

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