Jan. 16, 1962 J. J. KUPKA 3,016,819

SUPER CALENDER WITH CONSTANT NIP ALIGNMENT

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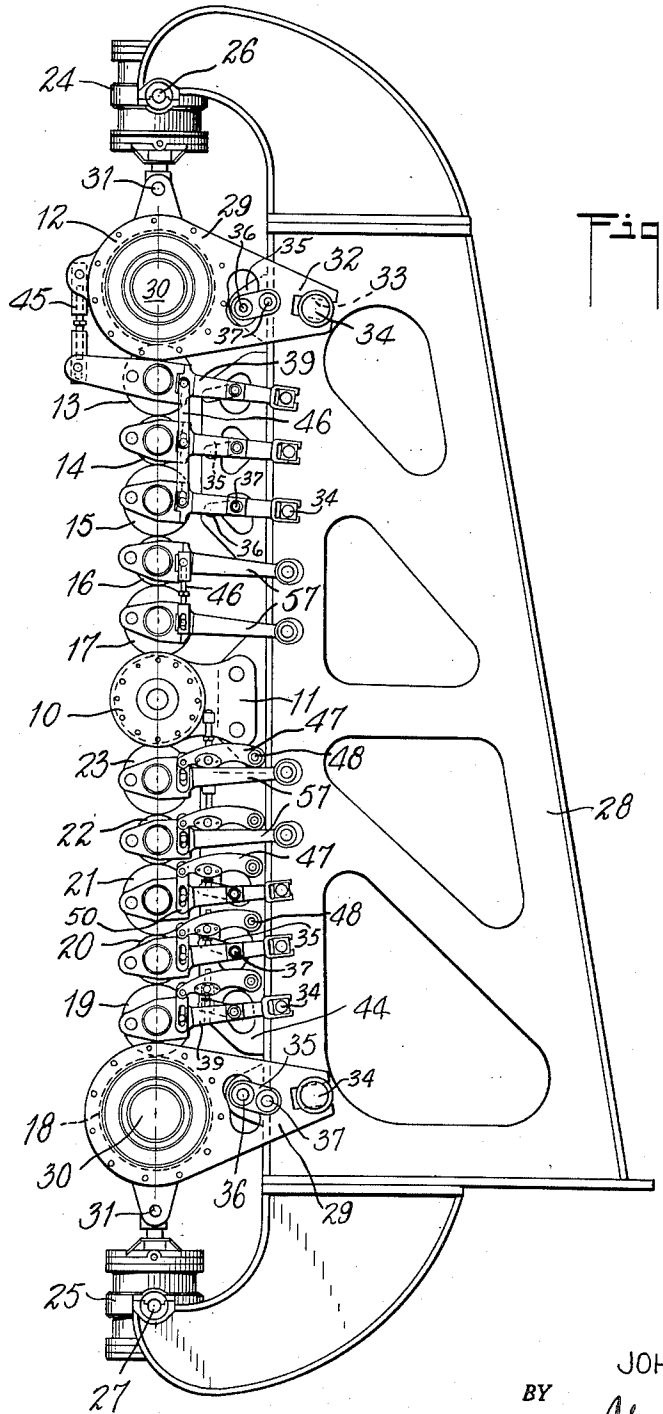


Fig. 1.

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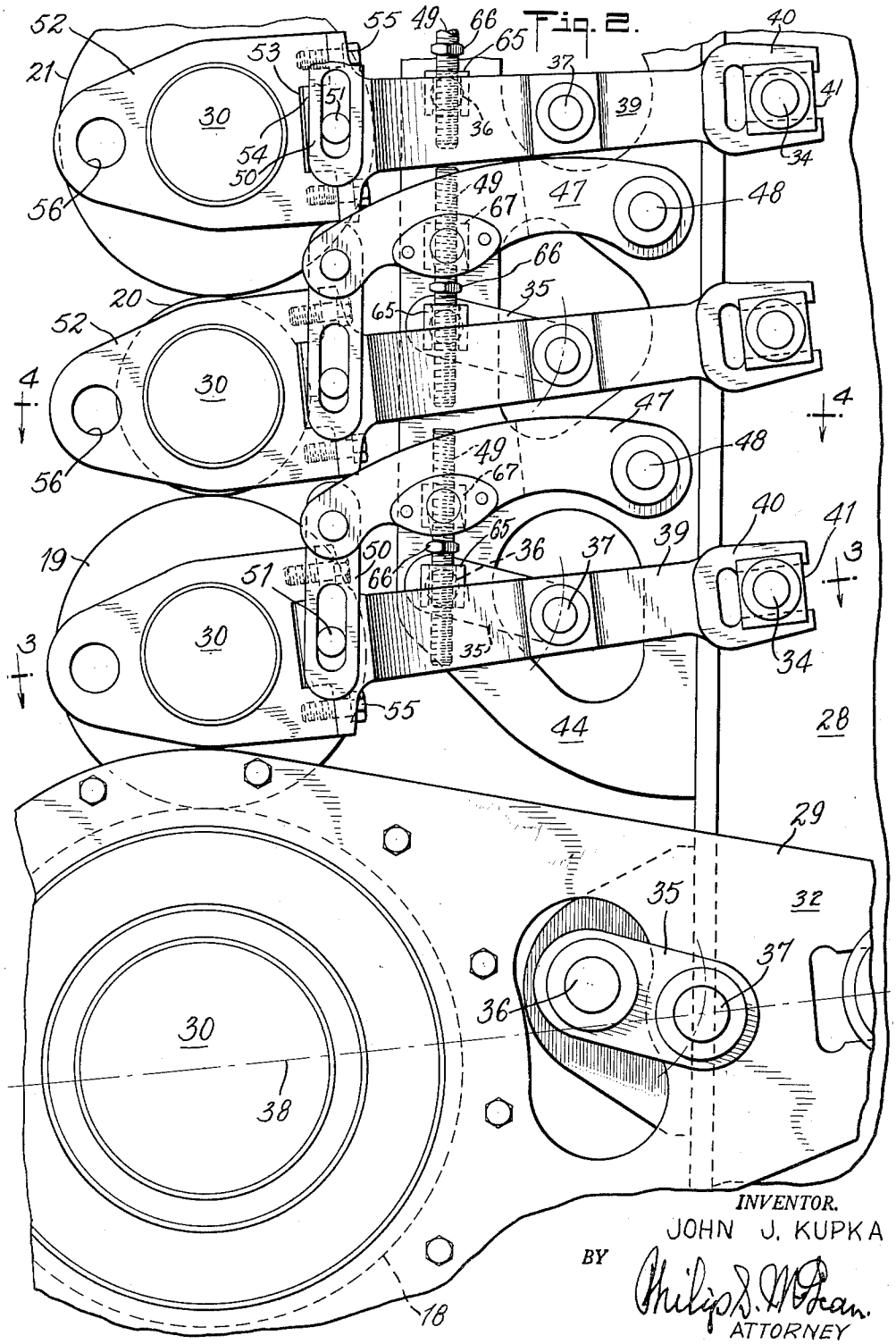
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Fig. 2.



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Fig. 3.

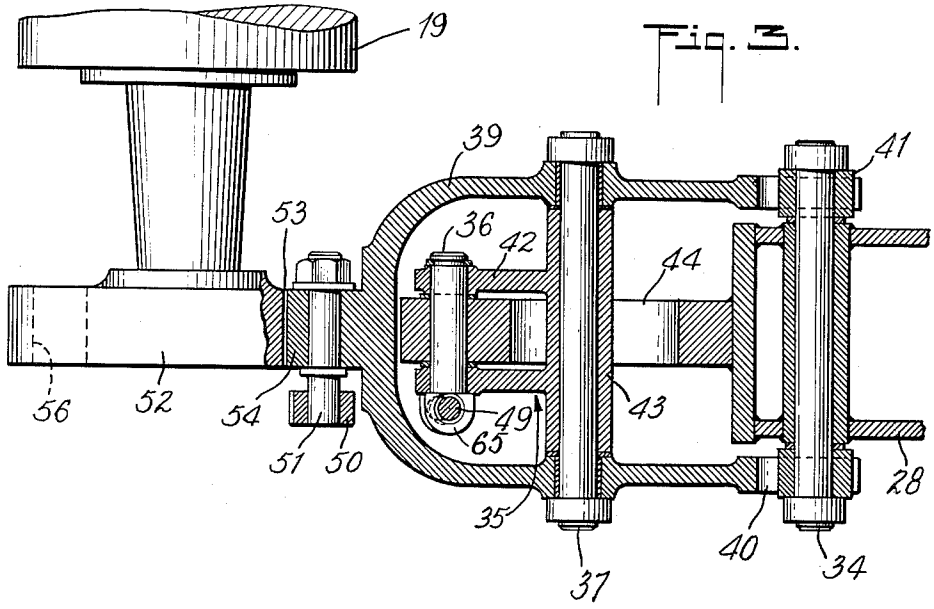
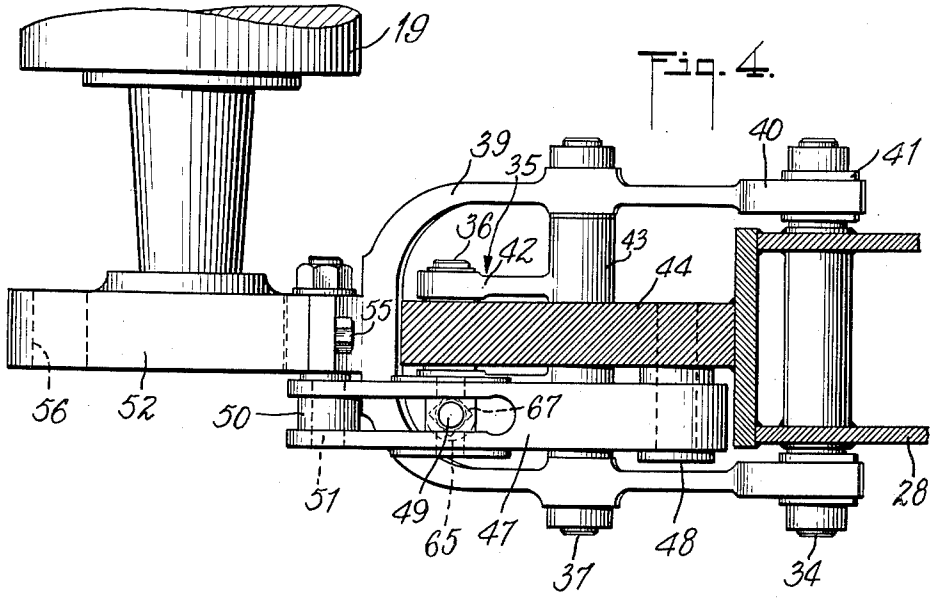


Fig. 4.



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SUPER CALENDER WITH CONSTANT NIP ALIGNMENT

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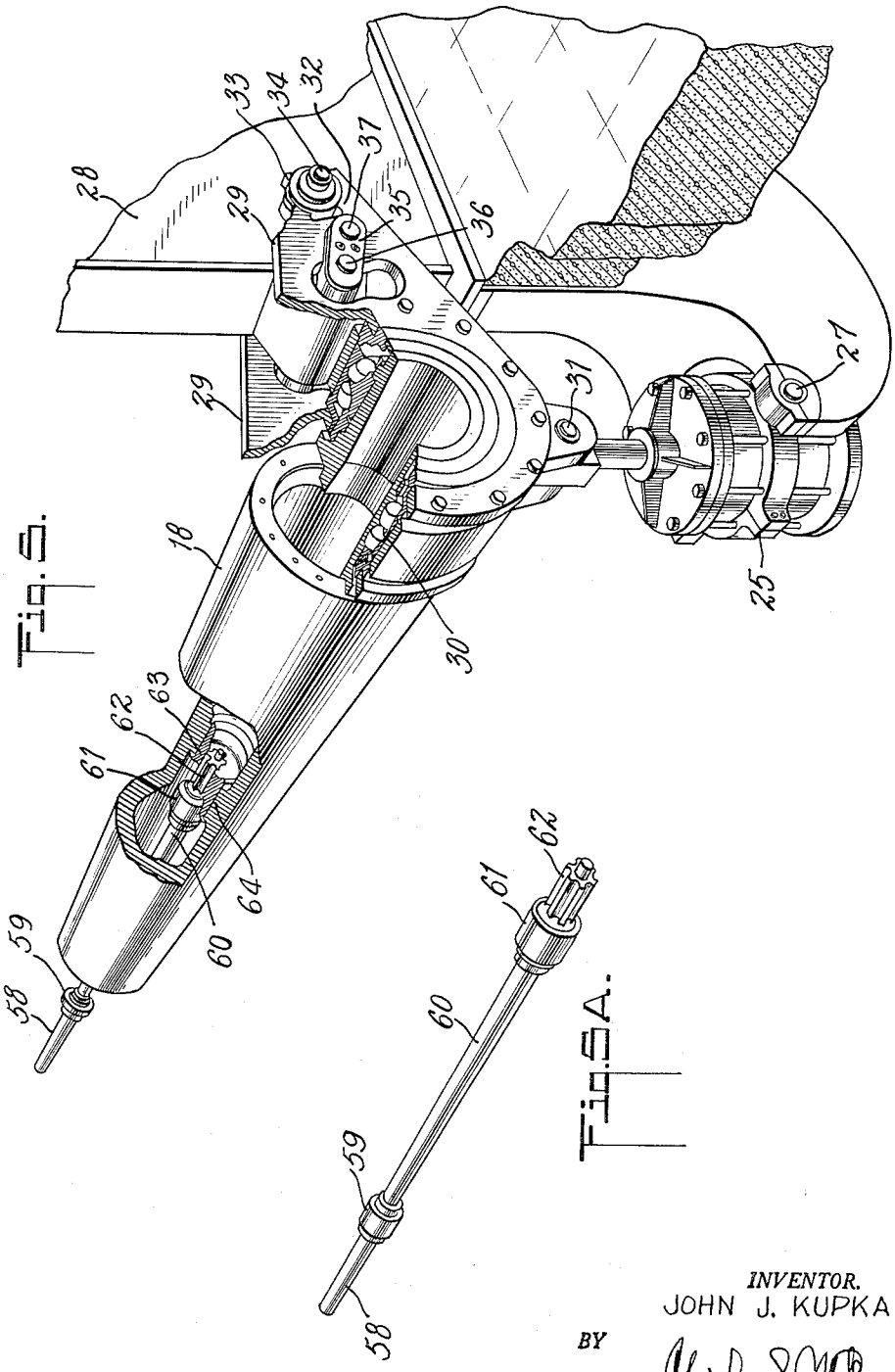


Fig. 5.

Fig. 5A.

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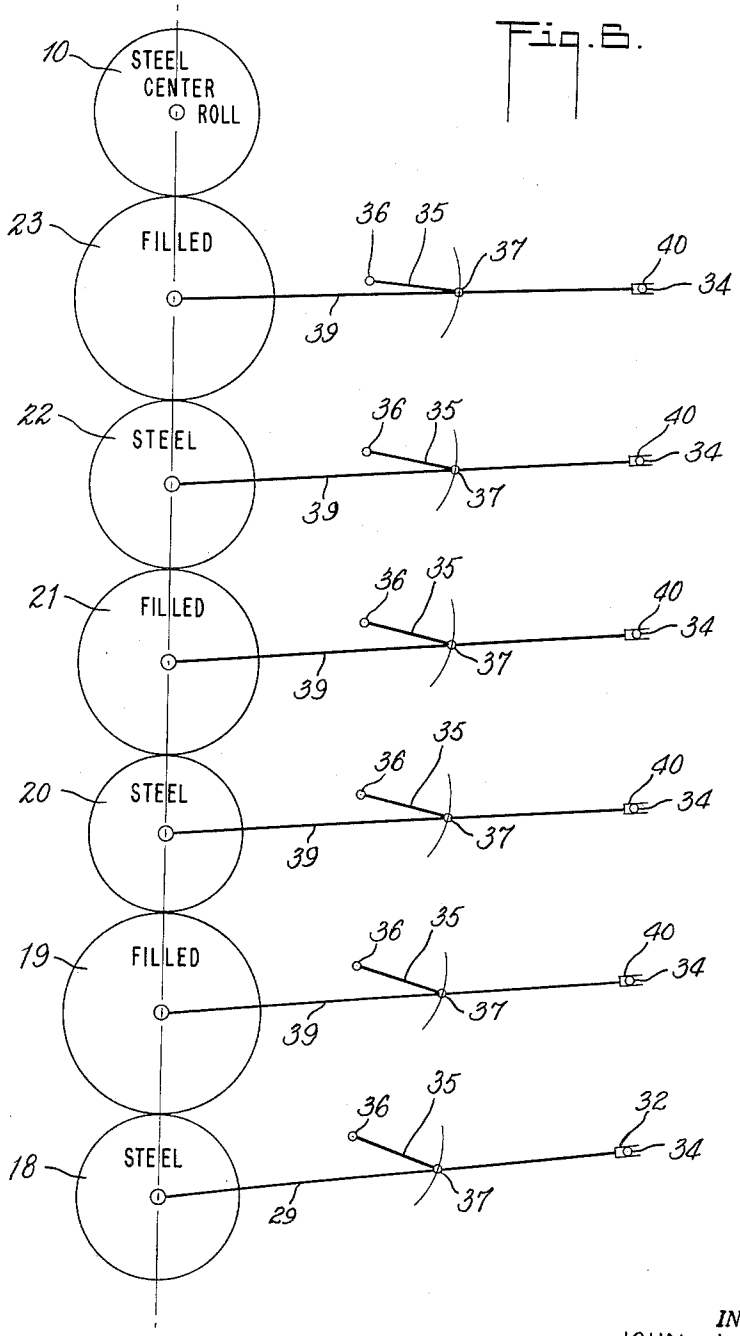
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Fig. 6.



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3,016,819

SUPER CALENDER WITH CONSTANT NIP ALIGNMENT

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13 Claims. (Cl. 100—163)

The invention herein disclosed relates particularly to machines of the super calender type in which there is a stack of cooperatively related filled and steel rolls.

As the filled rolls wear and are turned down the nip line changes and adjustments ordinarily have to be made to bring the nip between rolls back into an approximation of vertical alignment.

Special objects of the present invention are to automatically maintain this vertical alignment regardless of roll size so that with reduction in roll diameter the nip between companion rolls will be kept in the same vertical alignment.

Further special objects of the invention are to enable proper control of the nip pressure.

In earlier machines the king roll at the bottom of the stack has been supported in stationary bearings with the load of all rolls of the stack resting on this stationary bottom roll. This at times has meant a too great nip pressure on the bottom roll while the top or queen roll might have too light pressure. This was a disadvantage because the initial pressure at the queen roll might be quite important and this relation might present increasing pressure at the top roll because of pressure on the bottom roll being already too great.

In the present invention these possible objections are overcome by dividing the stack of rolls into upper and lower independently adjustable sets of rolls above and below and cooperating with a center roll mounted in fixed bearings, the lower, king roll being variably adjustable upwardly toward the fixed center roll and the upper queen roll being variably adjustable downwardly toward the fixed center roll.

Other special objects of the invention are to provide drive mechanism self-adjusting to the variable positions of the rolls and particularly to do so without extending the machine or taking up additional floor space.

Additional objects of the invention are to accomplish the results indicated in a machine of substantial, simple, practical construction.

The foregoing and other desirable objects are accomplished by further novel features of construction, combinations and relations of parts, all as hereinafter described and illustrated in the accompanying drawings.

These drawings illustrate a present commercial embodiment of the invention. Structure however may be modified and changed as regards the immediate illustration, all within the true intent and broad scope of the invention as hereinafter defined and claimed.

FIG. 1 in the drawings is a side elevation of a super calender having the invention incorporated therein.

FIG. 2 is a side elevation on a larger scale of the lower, king roll and the three rolls next above it, parts broken away, showing these rolls in normal cooperative relation.

FIG. 3 is a broken sectional view on substantially the plane of line 3—3 of FIG. 2 showing the lower filled roll in lowered position with the compensating linkage holding that roll in the vertical nip line.

FIG. 4 is a similar view on substantially the plane of line 4—4 of FIG. 2 showing linkage for the steel roll above the lower filled roll.

FIG. 5 is a broken part sectional perspective view of the king roll showing the roll adjusting and compensating mechanism and the balanced internal center drive for that roll.

FIG. 5A is a detail perspective view of the universal internal drive shaft for the king roll.

FIG. 6 is a diagrammatic view illustrating the self-aligning action of the calender rolls of different diameters.

The calender shown is of a double acting type having a center roll **10**, FIG. 1, journaled in fixed bearings **11**, with a queen roll **12** at the top applying pressure downwardly on alternately arranged filled and steel rolls **13**, **14**, **15**, **16**, **17** toward the fixed center roll and a king roll **18** at the bottom applying pressure upwardly on alternate filled and steel rolls **19**, **20**, **21**, **22**, **23** toward the fixed center roll.

Lifting and lowering forces are shown applied to the top and bottom rolls through the medium of air cylinders **24** and **25** pivoted on bearings **26**, **27** on the frame **28**.

The top and bottom sets of rolls are journaled in swinging arms or elbow levers so that each set may rise or lower as a group with respect to the center roll in addition to being independently adjustable.

The mountings for the king and queen rolls are similar so that description of one will suffice for the other.

These mountings each consist of parallel arms **29**, FIG. 5, carrying between them a bearing **30** for one end of the roll and having a pivotal connection **31** for the power cylinder at that end of the roll.

The mounting arms **29** for the top and bottom rolls are shown as having forked ends **32**, FIGS. 1 and 5, slidingly engaged over the blocks **33** pivoted on the fulcrum centers **34** so that these rolls may adjust horizontally as well as vertically to hold to a definite vertical alignment.

This vertical alignment is automatically maintained and effected in the illustration by the provision of compensating links which will automatically shift the roll carrying arms radially to offset the extent of radial travel which would take place if these arms were of fixed length between roll and fulcrum centers.

In FIGS. 1, 2 and 5 the compensating links are shown at **35** pivoted at one end at **36** on fixed centers carried by the frame and pivoted at their other ends at **37** to the supporting arms **29**.

The centers **37** on the supporting arms are shown as in line with the roll centers **30** and the fulcrum centers **34**.

The fixed fulcrum centers **36** for the compensating links of the lower roll group are shown as above the center lines **38** in the lowered position of these rolls and to the opposite effect the fixed centers **36** for the upper group of rolls, in the lifted position of these rolls are above the center lines **38** of those rolls.

In the substantially horizontal position of the roll carrying arms the fixed and movable centers **36**, **37** may be in substantial alignment with the center lines **38**, with the compensating links then fully extended and ineffective to impart any radial movement to the roll carrying arms.

This relation between roll centers, fulcrum centers and control link centers may be the same or substantially the same for any and all rolls in either group.

The structure of roll carrying arms and control links however may vary to suit the characteristics of any or all such rolls.

In each instance however the compensating or control links are effective to hold the rolls centered on substantially the same vertical nip line despite the vertical and angular adjustment required to hold the rolls in necessary cooperative relation. For simplicity of illustration the same reference characters have been applied to the roll centers, **30**, fulcrum centers, **34**, fixed link centers, **36**, and movable centers, **37**, since the action of these parts is similar in all instances.

The structure of the supporting arms and the compensating links however may vary.

Thus the arms for the intermediate rolls may be in the form of forked levers 39, FIGS. 3 and 4, having bifurcated ends 40 slidable over pivot blocks 41 journaled on the fixed fulcrum centers 34 and the compensating links may be in the form of parallel links 42 pivoted on the centers 36 at one end and carrying at the opposite end a sleeve 43 between the arms of the fork 39 and engaged on the pivot stud 37 carried by those arms.

These views, FIGS. 3 and 4, show how the fulcrum pivots 36 for the compensating links may be carried by brackets 44 projected from the main frame 28.

Linkage is provided to enable the top roll in lowering to successively lower the rolls of the top group into cooperative relation with the center roll and with each other and apply pressure and to lift rolls of the top group into separated relation. Similarly there is linkage to lift rolls of the lower group into cooperative relation with each other and with the center roll and to lower these into separated relation.

Such linkage is indicated in FIG. 1 in the form of a lost motion connection 45 between the top roll arms 29 and arms 39 of the next lower roll 13, with lost motion link connections 46 to the successive lower roll carrying arms.

For the lower group the supporting linkage is shown as made up of levers 47 pivoted on the frame at 48, limited in their lowering movement by adjustable stops 49, FIG. 2, and having lost motion links 50 engageable with supporting pins 51 on the arms below the same.

These suspending and supporting links being pivotally connected at their opposite ends do not obstruct or oppose the self-compensating nip alignment movements of the rolls.

To facilitate removal of the rolls for centering, smoothing, reduction or other purposes the roll bearings 30 for the intermediate rolls are shown as carried by extensions 52 of the roll arms 39, immovably keyed on the ends of the latter by having angled seats or sockets 53 engaged over correspondingly angled projections 54 on the arms 39 and thus secured by the bolts 55, FIG. 2. On removal of these bolts the rolls on their bearings may be separated from their supporting arms. The bearing extensions 52 are shown as having openings 56 to be interlockingly engaged with means for removing the rolls from their normal supports.

While it may be desirable in many instances to have all the rolls at each side of the center roll self-compensating to maintain vertical alignment it is realized that one or more of these rolls possibly need not be of this construction since the variation from vertical alignment may be very slight.

This possibility is illustrated in FIG. 1 where two of the rolls at each side of the center roll are shown as mounted on non-compensating lever arms 57.

To balance the strain on the long, heavy top and bottom driven rolls they may be constructed as shown in FIG. 5 in tubular formation and the drive be extended through one or both ends of the tubular formation to more or less the center of the roll by a universally jointed shaft or shafts.

FIG. 5A shows such a shaft at 58 having a universal joint connection 59 with a shaft extension 60 which has the universal joint connection 61 with a spline 62 meshed with a corresponding socket 63 anchored in a web 64 in the mid-length portion of the roll.

With this construction power is applied at the center of the roll clear of the end bearings and hence with no loading, torque or unbalance on the bearings and no tendency to interfere with automatic alignment adjustment of the rolls.

This construction accommodates for any misalignment or changes in alignment and with a low angle of inclination as between the fixed and variable center sections of the drive shafting. The opening in the end of the roll through which the drive shafting extends is large enough to permit all necessary roll adjustments without the drive shafting contacting the roll end. With this construction also the maximum desirable driving power may be applied without overloading parts and in fact less power than heretofore required may be found sufficient with this new construction.

The compensating or corrective action of the control links 35 is illustrated diagrammatically in FIG. 6.

To prevent or remove skewing or possibly if desired to introduce a certain amount of skewing the control links 35 may have eccentric bearings at one or both ends adjustable for such non-skewing or skewing effects.

While alignment adjustments are effected in the illustration by radially shifting the roll carrying arms in respect to the fulcrum centers, it is contemplated that corresponding alignment adjustments may be effected by having the supporting arms fixedly pivoted at the fulcrum centers and mounting the roll bearings in radially shiftable relation on the arms, with the control links pivotally connected with such shiftable roll bearings.

The metal rolls, usually termed the "steel" rolls, may be of steel or chilled iron and the filled rolls be of usual or special paper or cotton or synthetic filled construction. As the filled rolls wear or get out of round they may be readily removed from the supporting arms without displacing the bearings and be turned down or trued up in other ways. They can be reduced in diameter to any allowable extent, the compensating links automatically taking care of such reductions in size, holding the rolls to the proper nip or bite line as they wear down or are otherwise reduced in diameter. It may be considered that these compensating or corrective links simply retract the roll centers to the same extent and to the opposite effect that these centers would be projeced if the lever arms between the pivot centers and roll centers were of a fixed length. This automatic compensation is a constant factor taking place even as the rolls wear down while the machine is in operation. Some rolls may wear faster than others and all wear or reduction in roll sizes accumulated in the total number of adjusted rolls is automatically compensated.

The structure through which such compensation is effected takes up but small space and can be located within the area required by the roll carrying arms and is of simple, rugged design, requiring no special attention.

The location of the compensating links between the sides of the roll carrying arms enables the pivot studs 36 for these links to be used as stop shoulders for the adjustable stop bolts 49 of the suspension links 47, these bolts extending down through projecting ends 65 of the studs and having the annular stop flanges 66. FIG. 2 shows the stop bolts 49 adjustably screw threaded in supports 67 on the suspension arms 47 and as extending freely down through the extensions 65 of the pivot studs 36 so that the stop flanges 66 on these bolts may engage the stop shoulders 65.

The division of the stack of rolls into upper and lower sets above and below the fixed center roll enables independent adjustment to be made for the upper and lower rolls and avoids loading the bottom roll with all the superposed rolls. This construction reduces wear and vibration and with the center roll in fixed bearings this roll may be made as heavy and as large in diameter as required for best results.

The driving to the center of the roll as illustrated in FIG. 5 in addition to advantages resulting from the reduced angularity of the universal connecting shafting 60 provides a saving in floor space since the inclined section of shafting is located within the hollow roll, taking up no floor space.

This construction, with the universal shafting extending inward to the mid-portion or to a far portion of the roll permits this shafting to be lengthened to reduce the

angles of inclination of this shafting with respect to the drive shaft and roll axis to best advantage.

What is claimed is:

1. A calender comprising a stack of cooperative calender rolls meeting on a common nip line, supporting arms pivoted on fixed centers and carrying bearings in which said rolls are journaled, means for vertically shifting said supporting arms about said fixed centers, means for enabling radial adjustment of the centers of said rolls with respect to said pivot centers and means automatically operable in said vertical shifting of said supporting arms for maintaining the centers of said rolls on said common nip line.

2. The invention according to claim 1 in which one of said calender rolls is of open ended construction and in which a universally jointed drive shaft extends inwardly through the open end of said roll into connected engagement with said roll at a point longitudinally inward of said open end to drive said roll irrespective of the shifting movements of the arms supporting said roll.

3. A self aligning open front super calender comprising a stack of cooperative calender rolls, some at least mounted for pivoting movement about a supporting center for adjustment to compensate for varying roll diameter, roll lifting and lowering means for pivoting said rolls about said supporting centers for effecting vertical adjustment to compensate for varying roll diameters and means actuated by said roll lifting and lowering means for automatically shifting said rolls horizontally in proportion to the vertical extent of travel to keep said rolls substantially aligned on a common vertical nip line.

4. The invention according to claim 3 in which the mounting of the rolls for pivoting movement is effected by levers on which the rolls are journaled, mounted to swing about first fixed pivot centers and said means for automatically shifting said rolls horizontally includes control links pivoted on second fixed centers at one end and pivotally connected with said levers at the other end, arranged with said pivot centers of the links substantially in line with the first fixed pivot centers and roll centers when said levers are in a substantially horizontal position.

5. A double pressure, self-aligning super calender comprising a stack of cooperating calender rolls arranged on a common vertical nip line and including an intermediate roll on fixed bearings and alternated filled and steel rolls above and below the same, power means for lifting and lowering the upper and lower sets of rolls above and below the fixed intermediate roll, horizontally and vertically movable supports for the upper and lower sets of rolls and means for automatically maintaining the upper and lower sets of rolls on said common nip line in the vertical shifting movements of said rolls and including means for horizontally shifting the rolls in such vertical movements of the same, said latter means including compensating links pivotally supported at one end and pivotally connected at the opposite end with said horizontally and vertically movable supports, the compensating links for the upper and lower sets of rolls respectively being inclined in opposite directions.

6. A calender comprising a stack of cooperative calender rolls, arms pivotally supporting said calender rolls on a common nip line, fixed pivot studs for said arms, said arms having radially slidable engagement on said fixed pivot studs enabling adjustment of the arms to shift the rolls into position on said common nip line and control links mounted on fixed pivots and pivotally connected with said arms for shifting said arms radially in movement of the same about said pivot studs to hold the rolls aligned on said nip line.

7. A calender comprising a frame, pivot studs on said frame, pivot blocks pivotally mounted on said studs, roll supporting arms having forked ends slidably engaged over said pivot blocks, roll bearings on the opposite ends of said arms, calender rolls journaled in said bearings and roll positioning links pivotally supported at their one ends and pivotally connected at their opposite ends with said roll supporting arms and proportioned to shift said arms radially in respect to said pivot blocks in the pivotal movement of said arms about said pivot studs.

8. A calender comprising a frame, pivot studs on said frame, pivot blocks pivotally mounted on said studs, roll supporting arms having forked ends slidably engaged over said pivot blocks, roll bearings on the opposite ends of said arms, calender rolls journaled in said bearings and roll positioning links pivotally supported at their one ends and pivotally connected at their opposite ends with said roll supporting arms and proportioned to shift said arms radially in respect to said pivot blocks in the pivotal movement of said arms about said pivot studs, said roll bearings being detachably connected with the ends of said roll supporting arms and said positioning links being located between the points of detachment of said bearings and said pivot studs whereby to remain in position upon detachment of the roll bearings from the arms.

9. A calender comprising a frame, pivot studs on said frame, pivot blocks pivotally mounted on said studs, roll supporting arms having forked ends slidably engaged over said pivot blocks, roll bearings on the opposite ends of said arms, calender rolls journaled in said bearings and roll positioning links pivotally supported at their one ends and pivotally connected at their opposite ends with said roll supporting arms and proportioned to shift said arms radially in respect to said pivot blocks in the pivotal movement of said arms about said pivot studs, said supporting arms being of forked construction with parallel side portions and said positioning links being located between said parallel side portions and including sleeves extending between said side portions and pivot pins extending through said side portions and interposed sleeves and forming pivotal connections between said links and arms.

10. A calender comprising a frame, roll supporting arms consisting each of spaced parallel plates pivoted and radially slidable on said frame, roll bearings mounted on said roll supporting arms, at a distance from the centers on which said plates are pivoted on the frame, parallel links pivoted on said frame at points between the roll bearings and said pivot centers of said side plates, said links being pivotally connected with said side plates to shift said plates radially in respect to said pivot centers on movement of the plates about the pivot centers and a calender roll journaled in said bearings.

11. A calender comprising a frame, roll supporting arms consisting each of spaced parallel plates pivoted and radially slidable on said frame, roll bearings mounted on said roll supporting arms, at a distance from the centers on which said plates are pivoted on the frame, parallel links to pivoted on said frame at points between the roll bearings and said pivot centers of said side plates, said links being pivotally connected with said side plates to shift said plates radially in respect to said pivot centers on movement of the plates about the pivot centers and a calender roll journaled in said bearings, said calender roll being open at one end and a universally jointed drive shaft extending through said open end and connected with said roll at a mid-point in the length thereof.

12. Super calender comprising the combination of a stack of alternately disposed filled and "steel" rolls arranged on a common nip line, said filled rolls being subject to change in diameter through wear and other causes, pivotally mounted radially shiftable supporting arms in which said rolls are journaled and means for automatically shifting said supporting arms radially in respect to the pivot centers of said arms to maintain the roll centers on the common nip line regardless of changes in roll diameters.

13. A double pressure, self-aligning super calender comprising a stack of cooperating calender rolls arranged

on a common vertical nip line and including an intermediate roll on fixed bearings and alternated filled and steel rolls above and below the same, power means for lifting and lowering the upper and lower sets of rolls above and below the fixed intermediate roll, horizontally and vertically movable supports for the upper and lower sets of rolls and means for automatically maintaining the upper and lower sets of rolls on said common nip line in the vertical shifting movements of said rolls

and including means for horizontally shifting the rolls in such vertical movements of the same.

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