Nov. 17, 1964 D. A. GODDARD 3,157,110

CALENDER

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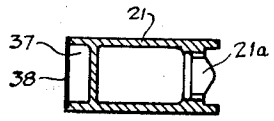


FIG. 7

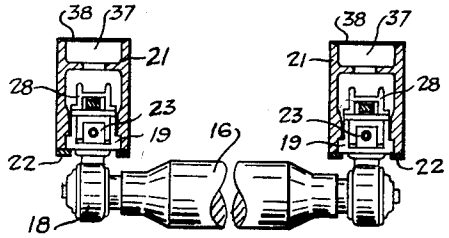


FIG. 3

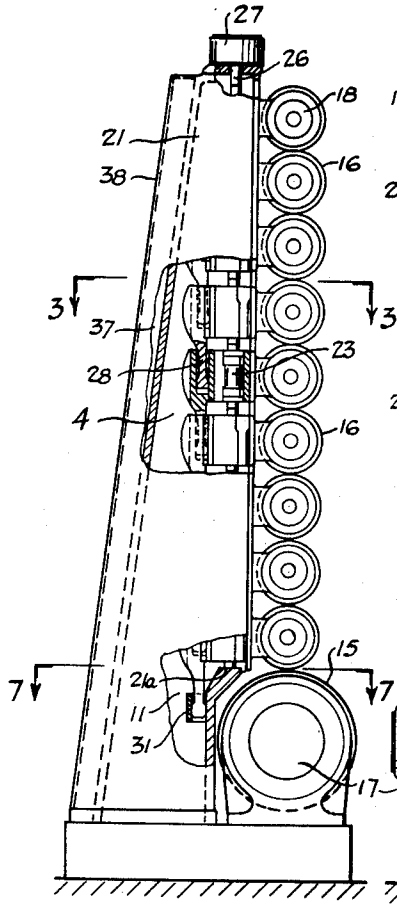


FIG. 1

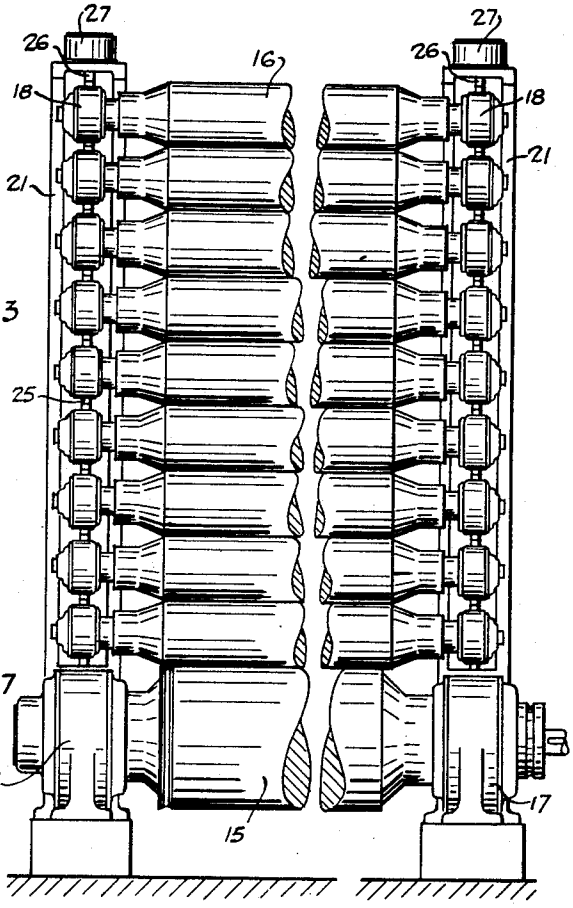


FIG. 2

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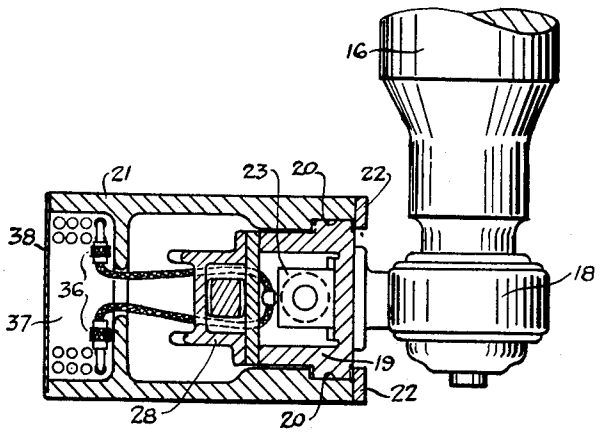


FIG. 5

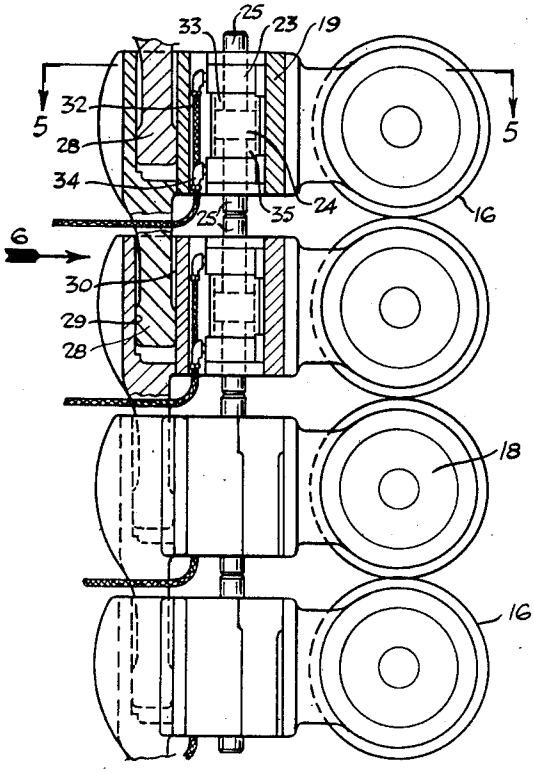


FIG. 4

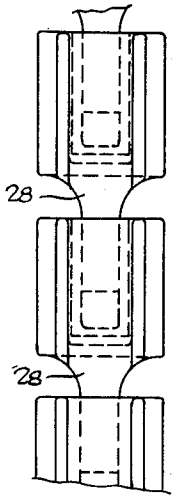


FIG. 6

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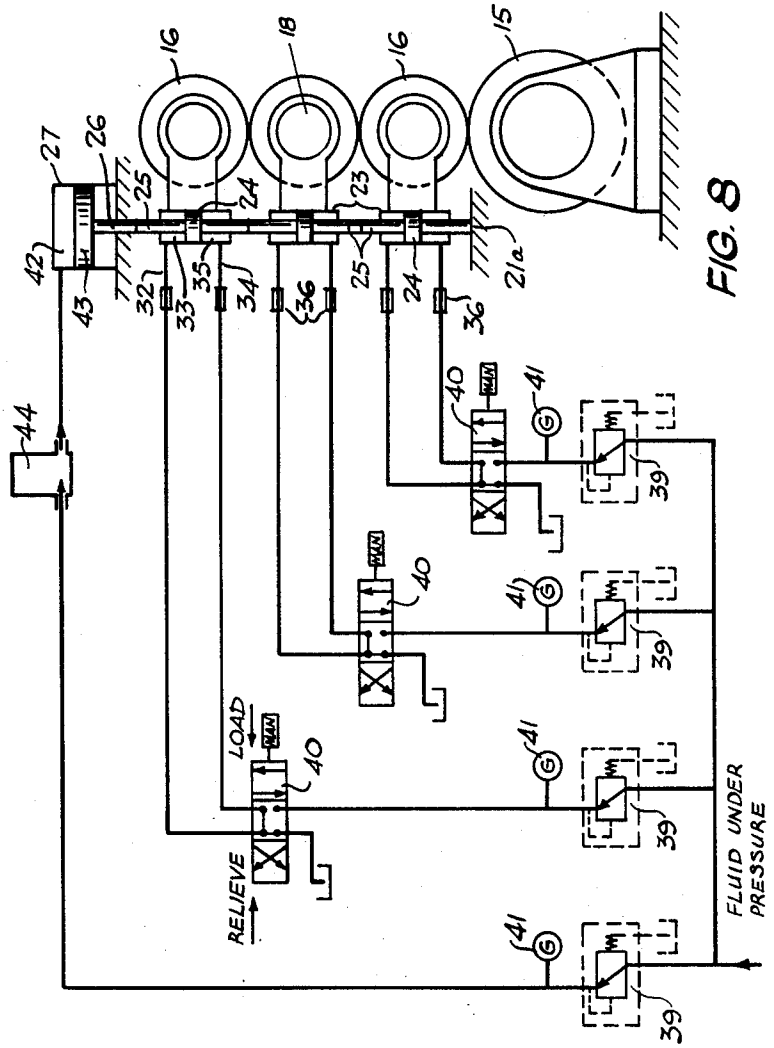


FIG. 8

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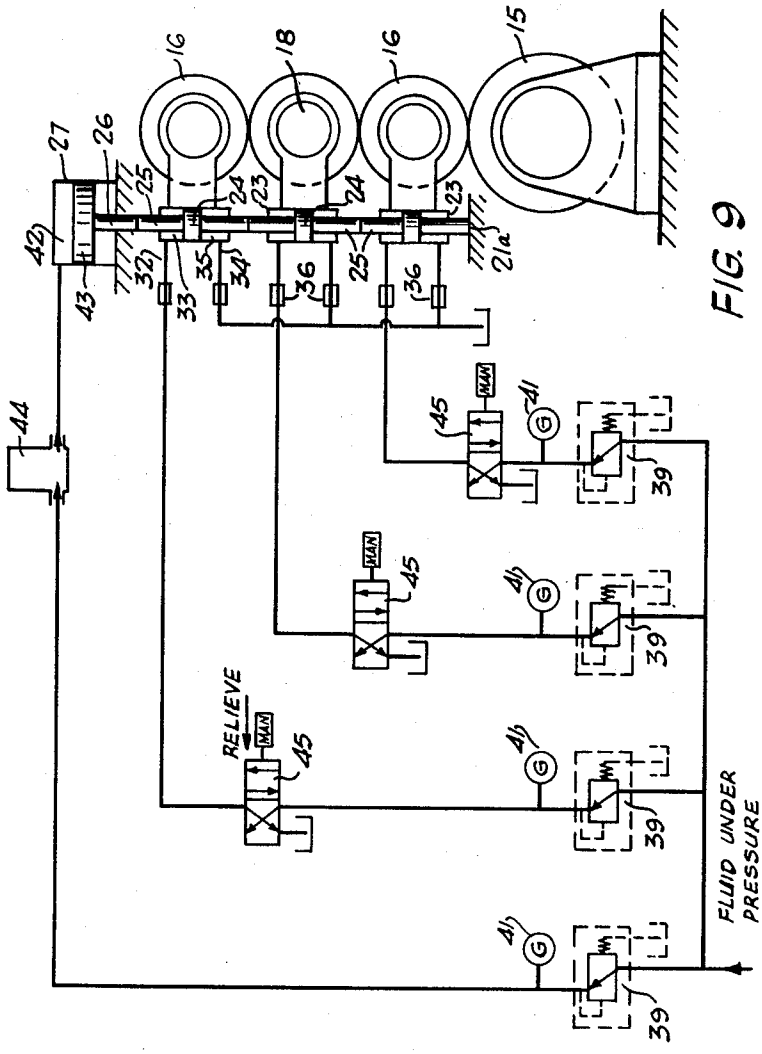


FIG. 9

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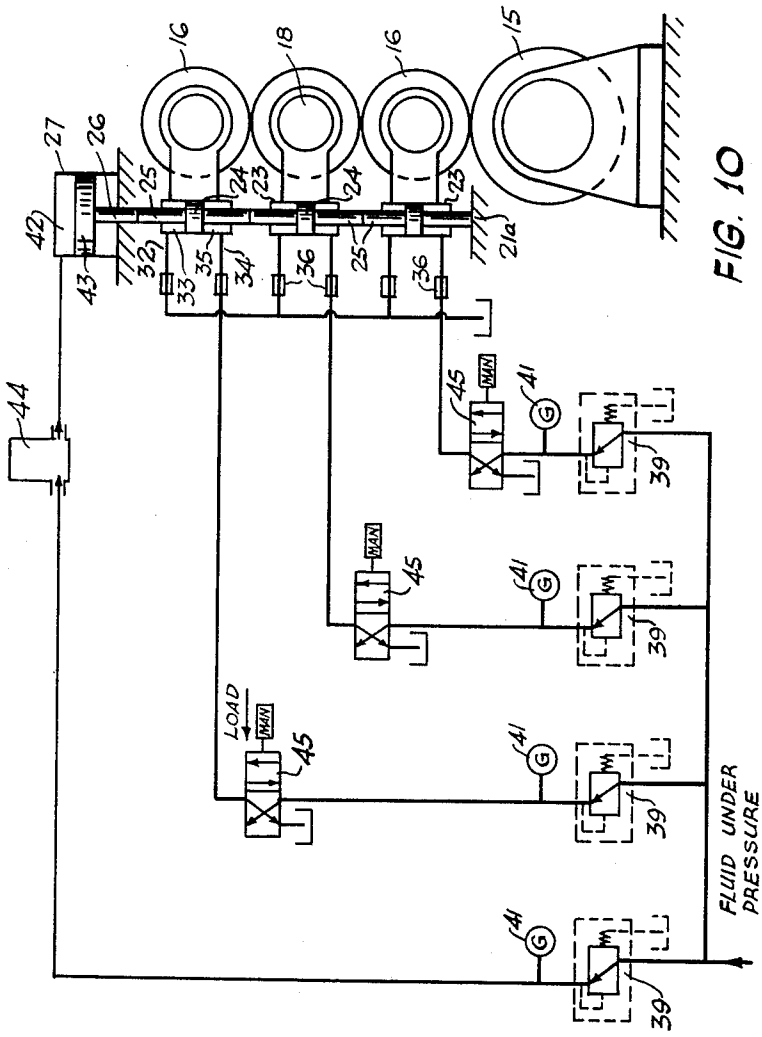


FIG. 10

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United States Patent Office 3,157,110 Patented Nov. 17, 1964

3,157,110

CALENDER

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Filed Apr. 29, 1963, Ser. No. 276,486
Claims priority, application Canada, Dec. 13, 1962, 864,526
10 Claims. (Cl. 100—170)

This invention relats to multi-nip calender stacks used in the paper making and other industries for calendering material in sheet, web, or strip form.

In the present instance, the invention will be described as embodied in a calender stack for use in the paper making industry, but it will be understood that the same principles and features of construction may be employed in calender stacks designed for use in the textile and other industries, under conditions where nip-pressure regulation is an important factor.

A conventional calender stack arrangement widely used in the paper making industry at the present time is an open-side type of calender stack comprising, a pair of roll-carrying arms for each calender roll pivoted to the calender frame and fluid-pressure actuated nip-pressure relieving means including said roll-carrying arms for applying upward pressure on the rolls to relieve load or nip-pressure at one or more of the nips, while at the same time, leaving the rolls free to be lifted by other agencies.

One disadvantage of the conventional open-side calender stack described above is that the rolls are not under control when they are lifted, or jump, due to lumps of paper or other foreign bodies passing through any of the nips.

Another disadvantage of the conventional nip-pressure relieving means referred to is that no provision is made for increasing the load or nip-pressure at the nips, a requirement particularly desirable in the case of calenders having small diameter rolls, wherein intensity of nip-pressure is required, greater than that produced by the gravitational effect of the rolls. In addition, the design of the conventional arrangement referred to is such that the calender stacks are expensive to produce and maintain, and that large number of access openings must be provided in the calender frame for assembly and for servicing operations.

It is the main object of this invention to provide a simple means for increasing or decreasing the load or nip-pressure at any or all of the nips in a calender stack, and to arrange for better control of roll jumping.

Another object of this invention is to provide a calender stack with a minimum number of component parts, thereby reducing both the initial construction costs and the maintenance costs.

A further object is to provide a calender frame structure comprising the attributes of structural rigidity, simple machining requirements, clean exterior appearance and improved accessibility of internally housed mechanisms.

According to the present invention the supporting means for each roll includes fluid-pressure responsive means for applying either an upward or a downward force on the roll depending on whether it is desired to relieve or increase the nip-pressure at the nip formed by and between said roll and the next lower roll. Another feature of this invention resides in the fact that the supporting means for each roll is designed to provide for controlled upward movement of the rolls in the case where a large lump or "wad" of paper or other object passes through any one of the nips.

These features are characterized in this invention by effectively mounting each of the calender roll bearing housings, with the exception of those for the bottom or

"king" roll, on fluid cylinders which are slidably mounted for vertical movement in the calender frame structure. The piston rods in adjoining fluid cylinders abut each other, with the top cylinder piston rods abutting the piston rods of the fluid reaction cylinders and the bottom cylinder piston rods abutting the frame structure, thus effecting a continuous piston rod structure through the pistons of the fluid cylinders at each side of the calender.

Guideways are machined in the fluid cylinder housings and reaction arms extend downwardly from the housings and slidably co-operate with the corresponding guideways in the housings immediately below. In this way, reaction to roll weight and loading is provided by the fluid cylinder housings immediately below, with the bottom reaction arms reactively co-operating with ways attached to the calender frame structure. Thus, the complete system is interdependent.

When pressure is applied to either side of the pistons in the fluid cylinders, reaction to the pressure is supplied, through the piston rod structure, by either the frame structure or the reaction cylinders. Therefore, the pistons remain stationary, while the cylinders, and with them the rolls, are urged upwardly or downwardly to provide nip-relief or nip-loading respectively.

The feature of separate, but abutting, piston rods allows nips to separate when lumps pass through which are solid enough to displace the pistons in the reaction cylinders and which would otherwise cause high stresses and possible damage to the structure.

A preferred embodiment of the invention is illustrated by way of example in the accompanying drawings in which:

FIG. 1 is a side elevation, partly in section, of a calender stack embodying this invention.

FIG. 2 is a front elevation corresponding to FIG. 1.

FIG. 3 is a section taken at 3—3 in FIG. 1.

FIG. 4 is a view to an enlarged scale and partly in section, of the roll supporting arrangement, as shown at 4 in FIG. 1.

FIG. 5 is a part sectional view taken at 5—5 in FIG. 4.

FIG. 6 is a fragmentary rear elevation of the reaction arms, taken in the direction of arrow 6 in FIG. 4.

FIG. 7 is a section taken at 7—7 in FIG. 1, showing the frame reaction stop.

FIG. 8 is a hydraulic circuit diagram showing a conventional arrangement of components and piping layout, providing one execution of fluid-pressure control for use of this invention for nip-relief, or alternatively, nip-loading.

FIG. 9 is an alternative hydraulic circuit diagram showing a conventional arrangement of components and piping layout, providing the necessary fluid-pressure control for nip-relief only.

FIG. 10 is an alternative hydraulic circuit diagram showing a conventional arrangement of components and piping layout, providing the necessary fluid-pressure control for nip-loading only.

With reference now to the figures, the calender stack comprises a large diameter bottom or king roll 15 and a plurality of superimposed smaller diameter calender rolls 16. The king roll 15 is journaled in large capacity bearings 17, preferably mounted on the machine room floor, and each calender roll 16 is journaled in smaller bearings and housings 18 which are secured to bearing carriers 19 slidably mounted in ways 20 (FIG. 5) machined in the frame structure 21. Keeper plates 22 are bolted to frame structure 21 to retain the bearing carriers 19 in ways 20.

Rigidly secured inside each bearing carrier 19 is a fluid cylinder 23. Each fluid cylinder 23 is provided with a pitson 24 having opposed piston rods 25 which extend outwards from piston 24, through the opposite ends of cylinder 23.

The piston rods 25 are stacked in end to end abutting relation, the bottom ends of the lowermost piston rods 25 abutting machined bases 21*a*, shown at 11 in FIG. 1 and FIG. 7, which form part of the frame structure 21, and the top ends of the uppermost piston rods 25 being in end to end abutting relation with the piston rods 26 of the reaction cylinders 27.

Each bearing carrier 19 has, secured to its side remote from the bearing 18, a reaction arm 28 (FIGS. 4 and 6) which projects vertically, preferably downwardly, as shown in the figures. Each reaction arm 28 has, at the level of its adjoining bearing carrier 19, a guideway portion formed by the slide faces at 29 and 30. The projecting portion of each reaction arm 28 nests slidably in the guideway portion of the lower adjacent reaction arm 28, so providing a long effective crosshead guide which prevents "cocking" of bearing carriers 19 in ways 20. Reaction arm 28 of the lowermost bearing carrier 19 is slidably mounted in a fixed reaction bracket 31 (FIG. 1) secured to frame structure 21.

Each fluid cylinder 23 has a flexible pipe 32 connected thereto to supply pressure fluid to the space 33 in fluid cylinder 23 above piston 24 and another flexible pipe 34 to supply pressure fluid to space 35 in fluid cylinder 23 below piston 24.

Flexible pipes 32 and 34 are coupled to their respective headers by means of "quick disconnect" couplings 36. All piping is housed in cavities 37 formed in the rear portions of frame structure 21, and closed by cover plates 38 which provide protection for, and allow access to, all piping and controls.

Reference will now be had to FIG. 8, which shows one conventional arrangement of components and piping providing fluid-pressure control for use of this invention for nip-relief, or alternatively, nip-loading. It should be noted that in this arrangement, fluid-pressure is fed in parallel to similar components, as hereinafter referred to, on each side of the calender.

Fluid under pressure is supplied to fluid cylinders 23 through pressure reducing valves 39 and 4-way 3-position manual control valves 40, with pressure gages 41 positioned in the circuit for fluid-pressure regulation.

Reaction cylinders 27 are supplied with fluid under pressure from the same source as fluid cylinders 23, through a pressure reducing valve 39, using a pressure gage 41. Positioned close to reaction cylinders 27 are means for allowing fast "dumping" of the fluid in the spaces 42 in cylinders 27 above pistons 43. This means may be in the form of nitrogen loaded accumulators 44, or conventional dump valves.

The operation of this invention using the arrangement for nip-relief or nip-loading, as shown in FIG. 8, is as follows:

To reduce nip-loading, 4-way 3-position manual control valves 40 are moved to the right and fluid under pressure is admitted to the upper spaces 33 in cylinders 23, thus exerting upward forces on the bearing carriers 19. Downward reaction forces are exerted on pistons 24 which are transmitted through piston rods 25 to the bases 21*a* at the bottom of frame structure 21.

To increase nip-loading, 4-way 3-position manual control valves 40 are moved to the left and fluid under pressure is admitted to the lower spaces 35 in cylinders 23, thus exerting downward forces on the bearing carriers 19. Upward forces are exerted on pistons 24 which are transmitted through piston rods 25 to the reaction cylinders 27 at the top of frame structure 21.

In the event of a lump of paper stock or other foreign object passing through one of the nips, all elements of the stack above the opened nip will be urged upwards, thus exerting an upward pressure sufficiently high to displace the pistons 43 in reaction cylinders 27, and exhausting the fluid in spaces 42 above pistons 43 to accumulators 44. This will allow the nip to open as required without the development of destructive forces in frame structure 21 or any other load-carrying components of the calender assembly.

Refer now to FIG. 9 which shows a conventional arrangement of components and piping, providing fluid-pressure control for nip-relief only.

Fluid under pressure is supplied to fluid cylinders 23 through pressure reducing valves 39 and 4-way 2-position manual control valves 45, with pressure gages 41 positioned in the circuit for fluid-pressure regulation.

In order to reduce nip-loading, 4-way 2-position manual control valves 45 are moved to the left and fluid under pressure is admitted to the upper spaces 33 in cylinders 23, thus exerting upward forces on bearing carriers 19.

Refer now to FIG. 10, which shows a conventional arrangement of components and piping, providing fluid-pressure control for nip-loading only.

Fluid under pressure is supplied to fluid cylinders 23 through pressure reducing valves 39 and 4-way 2-position manual control valves 45, with pressure gages 41 positioned in the circuit for fluid-pressure regulation.

In order to increase nip-loading, 4-way 2-position manual control valves 45 are moved to the left and fluid under pressure is admitted to the lower spaces 35 in cylinders 23, thus exerting downward forces on bearing carriers 19.

An advantage inherent in this invention is the fact that only a minimum of precision machining is required on frame structure 21, and amounts simply to the operation of facing straight flat ways and surfaces, which can be performed at a single set-up on a suitable general purpose machine tool.

The bulk of machining necessary to produce a calender assembly in accordance with this invention is confined to relatively small components with considerable reduplication, resulting not only in manufacturing economy but also in simplification in field servicing and replacement problems.

What I claim is:

1. A calender including a frame structure, a series of superimposed calender rolls, movable bearings in which the ends of each calender roll located above the bottom roll are rotatably journalled, fluid pressure cylinders slidably mounted for vertical movement in said frame structure on each side thereof and carrying said movable bearings, a piston positioned in each of said cylinders and a piston rod structure extending through the cylinders at each side of the frame structure and rigidly attached to the pistons arranged within said cylinders, means normally holding the piston rod structures against vertical movement and means for routing pressure fluid alternatively to and from opposite ends of each cylinder to effect upward or downward movement of the cylinders and the bearings carried thereby relative to said pistons and piston rod structures.

2. A calender as set forth in claim 1, in which said fluid cylinders are slidably mounted for vertical movement in vertical ways in said frame structure.

3. A calender as set forth in claim 1, including means for preventing cocking of said fluid cylinders in said ways.

4. A calender as set forth in claim 1, including means for preventing cocking of said fluid cylinders in said ways comprising, guideways positioned in the housings of said fluid cylinders and reaction arms extending vertically from said housings and slidably co-operating with said guideways in housings of adjacent fluid cylinders to provide effective cross-head guidance.

5. A calender as set forth in claim 1 including means for preventing cocking of said fluid cylinders in said ways comprising, guideways positioned in the housings of said fluid cylinders and reaction arms extending downwardly from said housings and slidably co-operating with said guideways in the housings of said fluid cylinders immediately below to provide effective cross-head guidance, the

lowermost reaction arms slidably co-operating with guideways positioned on said frame structure.

6. A calender as set forth in claim 1, in which said piston rod structure comprises individual piston rod sections in end to end abutting relation, one piston rod section being rigidly attached to each of said pistons.

7. A calender as set forth in claim 6, including bases positioned in said frame structure to provide reactive support for the lowermost of said individual piston rod sections, and means providing reactive support for the uppermost of said individual piston rod sections.

8. A calender including a frame structure, a series of superimposed calender rolls, fixed bearings in which the bottom roll of said series is journalled, movable bearings in which each of the remaining rolls in said series is journalled, fluid cylinders slidably mounted for vertical movement in vertical ways in said frame structure and arranged to carry the housings of said movable bearings, means for preventing cocking of said fluid cylinders in said ways, a piston positioned in each of said fluid cylinders and a piston rod structure extending through each of said fluid cylinders, said piston rod structure comprising individual piston rod sections in end to end abutting relation with one piston rod section being rigidly attached to each of said pistons, bases positioned in said frame structure to provide reactive support for the lowermost of said individual piston rod sections, reactive support means for the uppermost of said individual piston rod sections including reaction fluid cylinders and accumulator means for accommodating the fluid displaced by the movement of the pistons in said reaction fluid cylinders due to forced opening of a calender roll nip, and means for routing pressure fluid alternatively to and from either end of each of said fluid cylinders.

9. A calender including a frame structure, a series of superimposed calender rolls, movable bearings in which the ends of each calender roll located above the bottom roll are rotatably journalled, fluid pressure cylinders slidably mounted for vertical movement in said frame structure at each side thereof and carrying said movable bearings, a piston positioned in each of said movable cylinders and a piston rod structure extending through the cylinders at each side of the frame structure and rigidly attached

to the pistons positioned within said cylinders, each piston rod structure comprising individual piston rod sections arranged one above the other in end to end abutting relation with each piston rod section rigidly attached to the piston within the cylinder through which the piston rod section extends, means normally holding the piston rod structures against vertical movement and means for routing pressure fluid alternatively to and from opposite ends of each cylinder to effect upward movement of said cylinders relative to said pistons and piston rod structures.

10. A calender including a frame structure, a series of superimposed calender rolls, movable bearings in which the ends of each calender roll located above the bottom roll are rotatably journalled, fluid pressure cylinders arranged one above the other at each side of said frame structure and carrying said movable bearings, said cylinders being mounted for vertical movement in said frame structure, a piston positioned in each of said cylinders, a piston rod extending through the cylinders at each side of the frame structure and rigidly attached to the pistons positioned within said cylinders, means engaging the extreme upper and lower ends of each piston rod structure and normally holding said piston rod structure against vertical movement, the means engaging the uppermost ends of the piston rod structures to normally prevent upward vertical movement thereof being yieldable to permit upward movement of the piston rod structures and the associated cylinders to allow for the passage of a lump of paper stock or other object through one or more of the nips formed by and between the upwardly movable rolls.

References Cited by the Examiner

UNITED STATES PATENTS

2,850,952	9/58	Hornbostel	100—162
2,971,457	2/61	Hold	100—163
2,985,100	5/61	Hornbostel	100—163
2,992,866	7/61	Cavalieri	308—59

FOREIGN PATENTS

255,982	2/49	Switzerland.
1,072,476	3/54	France.

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