June 25, 1940. E. A. SCHWARZ ET AL 2,205,632

SUGAR CANE MILL

Filed Dec. 5, 1936 2 Sheets-Sheet 1

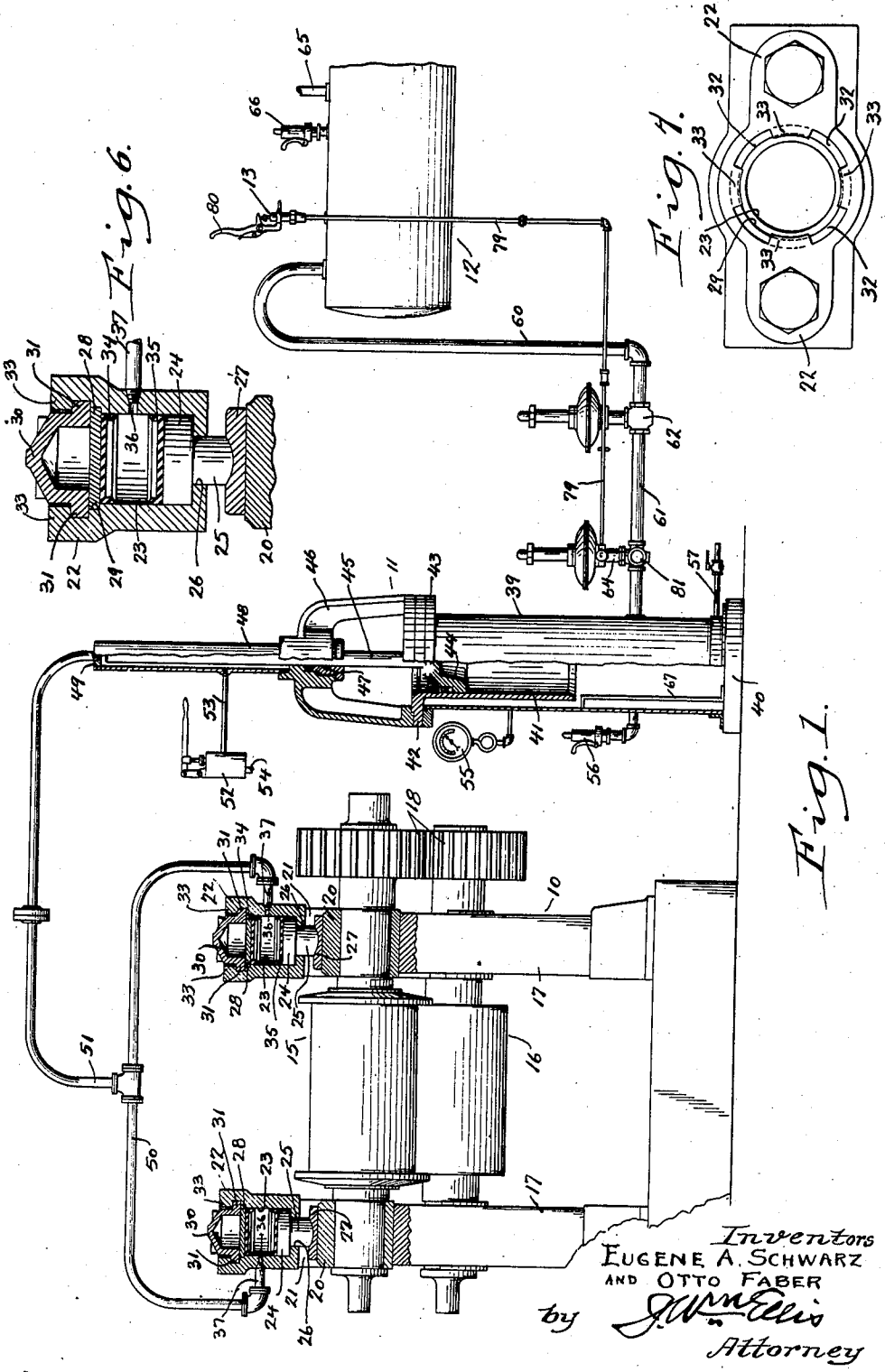


Fig. 1.

Fig. 4.

Fig. 6.

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Fig. 2.

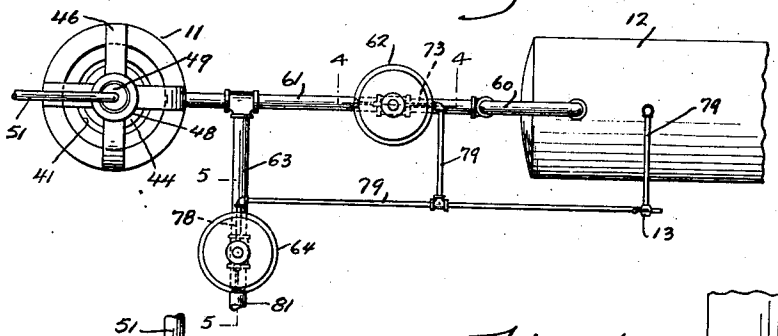


Fig. 3.

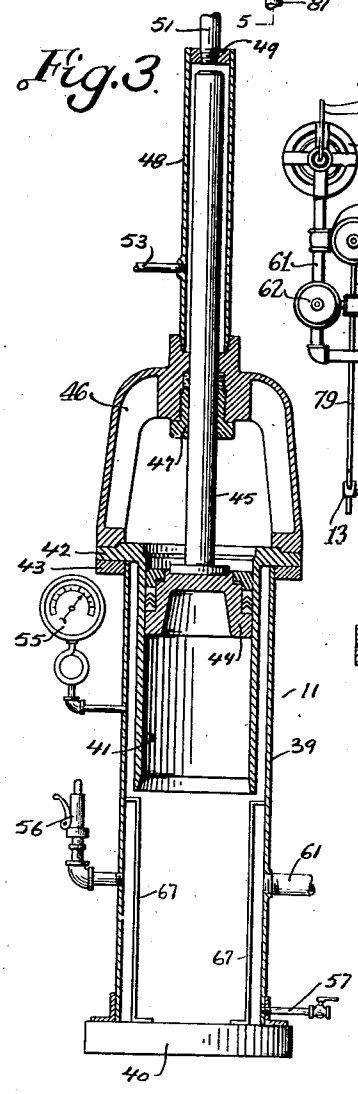


Fig. 4.

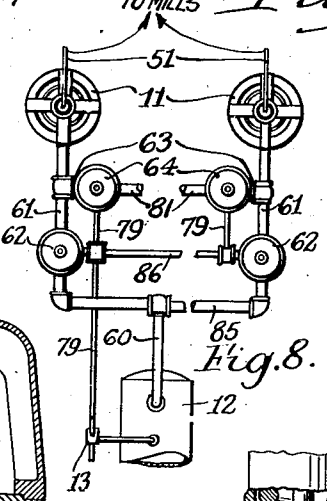
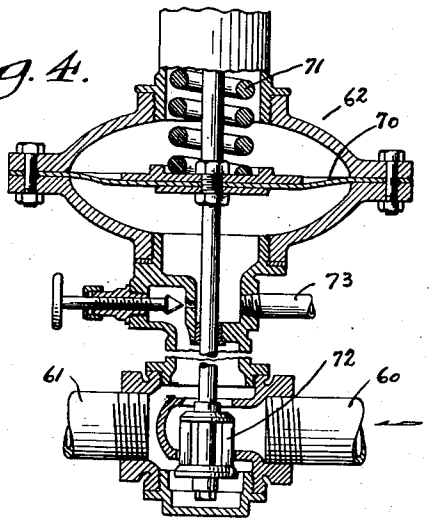


Fig. 8.



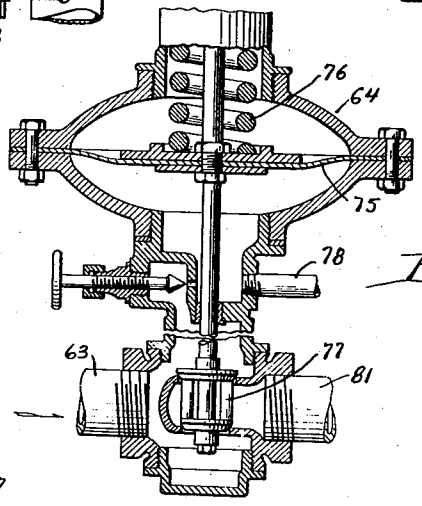


Fig. 5.

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SUGAR CANE MILL

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Application December 5, 1936, Serial No. 114,356

4 Claims. (Cl. 100—47)

Our invention relates in general to sugar cane mills and in particular to hydraulic accumulators and emergency controls for such mills.

It is well known to those skilled in the art that hydraulic accumulators formerly used on this class of machinery were actuated by weights placed on top of the accumulator, the pressure being governed by weights on the accumulator piston. The disadvantage of such a system, when weights are used, is that the inertia of the weight, when set in motion, must be taken into account when designing the apparatus, with the result that either the working weight is insufficient, under normal working conditions, or there will be an excess pressure exerted upon the piston due to the inertia of the weight when it is set in motion, thereby causing momentary overloading.

The principal object of our invention has been to provide a device of this nature having an accumulator, preferably of a differential type, whereby the pressure exerted upon the pistons of the mill bearing blocks will be taken by a separate piston which is subjected to substantially constant air pressure.

Another object has been to provide a device of such a nature that there shall be substantially no inertia to overcome when the parts are first placed in motion.

Another object has been to provide a device so designed that a number of mills may be controlled by a single conveniently located valve, whereby, in an emergency, the pressure upon all of the mills will be relieved.

Another object has been to provide sufficient reserve air so that a battery of accumulators may operate for fairly long periods of time without requiring the use of power to replenish air used therein.

Moreover, our device is so designed that the pressure exerted between the rolls may be more accurately indicated than is possible in present day devices.

Furthermore, our device is of such a nature that the air accumulator of each mill occupies a relatively small space and may be conveniently arranged in any desired position.

Moreover, our device is relatively inexpensive to manufacture and is simple in design so that it may be operated over long periods of time without adjustment or alteration.

The above objects and advantages have been accomplished by the device shown in the accompanying drawings, of which:

Fig. 1 is a side elevation, partly in section, of a single unit of our device.

Fig. 2 is a fragmentary, plan view showing portions thereof.

Fig. 3 is an enlarged, sectional view of the accumulator of one of the units of our device.

Fig. 4 is an enlarged, fragmentary, sectional view of the pressure relief device forming a part of our invention.

Fig. 5 is a similar view of an air relief valve forming a part of our invention.

Fig. 6 is an enlarged, fragmentary, sectional view of one of the bearing block cylinders of our device.

Fig. 7 is an enlarged, plan view of one of the housing yokes with the cylinder cap removed.

Fig. 8 is a diagram, illustrating a battery of mills controlled by our accumulator system.

In the drawings we have shown but one unit of our device comprising a sugar cane mill 10 and an accumulator 11 supplied with air from an air storage tank 12 and controlled by a single release valve 13, but it is obvious that the air storage tank and the emergency release valve can be used to control the usual or desired number of mills and accumulators.

Each of the mills comprises the usual rolls 15 and 16 mounted in suitable bearing standards 17 and driven by suitable gears 18. As is customary in mills of this type, the upper bearing blocks 20 are slidably mounted in suitable guides 21 at the upper end of which is stationarily arranged a housing yoke 22 or its equivalent, having a housing cylinder 23. In each of these cylinders is disposed a housing piston 24. Each of these pistons is provided with a downwardly extending piston rod 25 which passes through a suitable aperture 26 and has its lower end engaged with and bearing upon a plate 27 which rests on top of the bearing block 20. Arranged in the upper end of the cylinder is a spacer disc 28 which is disposed in an enlarged bore 29 and held within such bore by means of a cylinder cap 30. This cylinder cap is designed to keep the spacer disc 28 in place and it is secured preferably to the housing yoke by means of a bayonet joint, lugs 31 formed on the cap being engageable with yoke recesses 32 when the cap is being assembled and engageable with yoke lugs 33 when the cap is in assembled position (see Figs. 6 and 7). Within the cylinder are two packing rings 34 and 35, the former bearing against the spacer disc 28 and the latter being preferably secured to the top face of the housing piston 24, so that the joints at these points will be sealed. Each of the housing cylinders 23 is provided with an inlet

opening 36 to which is secured a fluid pipe 37, to be hereinafter described.

In carrying out our invention, one of the accumulators 11 shown in the drawings is provided for each of the mills used. Each of these accumulators preferably comprises an outer jacket 39 closed at the bottom by a head 40 which may also serve as a base for the accumulator. Each of the accumulators is preferably arranged vertically and may be supported upon the floor or upon a side wall, or be suspended from the ceiling. Within the jacket 39 is arranged an air cylinder 41 which extends into the jacket for only a portion of the length thereof, and this cylinder may be supported in any suitable and convenient way. For convenience of illustration, we have shown the cylinder as provided with a flange 42 which is supported upon a flange 43 carried at the top of the jacket. This air cylinder is preferably smaller than the jacket and is in interspaced relation therewith so as to give to the jacket a volumetric capacity such that there is very little rise in pressure in the jacket under the normal working range of the device. Slidably mounted within the air cylinder is an air piston 44 which is provided with suitable packing. In the lower end of the jacket 39, below the lower end of the cylinder 41, is preferably arranged a number of guides 67, so that if the piston 44 leaves the cylinder in its downward travel due to lowering of air pressure in the jacket or for other reasons, the piston will be guided within the jacket and kept in alignment with the cylinder so that it may be easily replaced within the cylinder, either manually or otherwise. The piston carries an upwardly extending piston rod 45 which is supported by an accumulator bearing bracket 46 arranged on top of and secured to the flanges 42 and 43 of the air cylinder and jacket of the accumulator. The bearing bracket 46 is provided with a stuffing box 47 above which is arranged an oil cylinder 48. The piston rod 45 is extended upwardly and provides a plunger for the oil cylinder, and this rod or plunger is sealed by means of the packing 47. The oil cylinder 48 is provided with a head 49 for closing the upper end thereof. The pipes 37, connected to the housing cylinders 23 of each mill, are connected together by means of a pipe 50. This pipe is provided with a branch pipe 51, which is extended to the oil cylinder 48 of the accumulator and which is connected to the head 49 of the oil cylinder, whereby a fluid-tight oil system is provided. The diameter of the piston rod 45 is relatively smaller than the diameter of the housing piston 24 and its displacement, therefore, is very much greater per unit of longitudinal movement than the displacement of the housing piston, whereby the pressure on the housing piston is made sensitively responsive to the action of the pressure of the air in the accumulator.

In order to compensate for any leakage of the oil from the oil system, we provide an oil pump 52 which is connected by means of a pipe 53 to the oil cylinder 48 and which takes its supply of oil from a suitable source (not shown) through the pipe 54. Obviously, when the supply is to be replenished, the pump is manually operated in well known manner and oil is forced under pressure into the oil system.

The air jacket 39 of the accumulator is provided preferably with a gauge 55, and it is obvious that, since the pressure of the air over the relatively large piston 44 is less than the pressure of the oil over the smaller plunger 45, the pressure within the oil system will be in definite relation to the pressure of the air in the air system and the oil pressure may, therefore, be accurately gauged from the pressure of the air in the jacket of the accumulator. So as to prevent the possibility of an overload in the jacket 39, a safety valve 56 is provided which, in the present case, is set to release at a pressure having a definite relation to the other valves to be hereinafter described. A suitable drain 57 is connected to the bottom of the tank whereby condensation may be removed.

The air storage tank 12 preferably has sufficient capacity for supplying air not only to the single accumulator shown in Figs. 1–7, inclusive, but to a series of accumulators, as illustrated diagrammatically in Fig. 8 and as hereinafter stated. The air jacket 39 of each of the air accumulators 11 is connected to the tank 12 by means of two pipes 60 and 61, joined together by means of a pressure regulating valve 62 which is designed to act also as a shut-off valve, as hereinafter described. The pipe 61 is provided with a branch 63 at the outer end of which is mounted an air relief valve 64. The air storage tank 12 is supplied with air under pressure from any suitable source (not shown) through a pipe 65, and a safety relief valve 66 is also provided on the tank. In Fig. 8 we show diagrammatically two accumulators 11 which are obviously to be connected by means of each of their pipes 51 to a mill, not shown. Each of these accumulators is provided with an air supply pipe 61, a branch pipe 63, a pressure regulating and shut-off valve 62 and a relief valve 64 connected in the manner similar to that described above in connection with the single accumulator. Furthermore, the pipe 79 carrying air from the supply tank 12 to the diaphragm chambers of the two valves just mentioned is also provided for each accumulator. In order that the accumulators be operated in unison and that the valves be operated in unison through the medium of the emergency release valve 13, we connect the pipes 79, coupling each pair of valves 62 and 64 with a branch pipe 86. Likewise, the air supply pipes 61 from each accumulator are connected to the supply pipe 60 coming from the air tank 12 by means of a branch pipe 85.

The pressure regulating and shut-off valve 62 and the air relief valve 64 are shown enlarged in Figs. 4 and 5, respectively. The pressure regulating and shut-off valve 62 comprises a diaphragm 70 forced downwardly by means of a helical spring 71, and a plug 72 which separates the pipes 60 and 61. Attached to the housing and connected to the space under the diaphragm 70 is an air supply pipe 73, to be hereinafter described, and the plug of this valve is so arranged that it opens upon pressure exerted on the under-side of the diaphragm, whereby it will also act as a shut-off valve under certain conditions, to be hereinafter described. The relief valve 64 comprises a diaphragm 75, a spring 76, and a plug 77. The plug 77 of the relief valve is arranged in reverse manner to the plug 72 of the pressure regulating and shut-off valve and is normally held upon its seat by the pressure of the spring 76 and by the pressure of the air in the pipe 63. This valve is also provided with an air pipe 78 attached to the casing of the valve and positioned so as to exert pressure on the under side of the diaphragm 75. The air pipes 73 and 78 are connected together by means of piping 79, which is in turn connected to the air storage tank 12.

Arranged in the air piping 79 is the emergency release valve 13. This release valve is of the spring-pressed type and is normally closed. The valve is so designed, however, that by a single movement of the lever 80 thereof, it may be unseated and allow air from the air storage tank 12 to pass through the piping 79 and to the chambers below the diaphragms 70 and 75 of the valves 62 and 64, respectively, to be hereinafter described. The outlet pipe of the air relief valve 64 opens into the atmosphere and may be connected to some suitable point outside of the building by means of a pipe 81.

When our device is to be put into use, air from the air storage tank 12 will pass through pipes 60 and 61 to the jacket 39 and cylinder 41 of the air accumulator. Such air, in passing to the accumulator, will pass through the pressure regulating and shut-off valve 62 and the pressure will be reduced to the amount desired to be maintained in the air accumulator. The parts of our device are so proportioned that, when the air has reached the desired pressure in the accumulator, the piston 44 thereof will have moved upwardly which, together with a corresponding movement of the plunger 45, will, through the oil in the oil system, place the upper roll under proper pressure. Obviously, the pressure of the air in the tank 12 and the capacity thereof is made ample to supply the number of accumulators used and to replenish any leakage of air from the accumulators without frequent operation of the air compressor (not shown) supplying air to the air storage tank. For practical purposes, we may designate two hundred pounds as the pressure which is preferable to maintain within the tank 12 and one hundred and fifty pounds as a pressure desirable for the jacket 39 of the air accumulator. The air in the accumulator is maintained at this definite pressure by means of the regulating valve 62, and the proper normal working pressure within the housing cylinders 23 is thereby maintained. It will be obvious that when our device is operating under normal working conditions, the air relief valve 64 will be maintained in its closed position.

When sugar cane is now passed between the rolls 15 and 16 of the mill, the upper roll will be separated from the lower roll and the oil or fluid contained in the bearing block cylinders 23 will be forced out through the pipes 37 and through the pipes 50 and 51 to the oil cylinder 48. The flow of oil into the cylinder 48 causes movement of the piston rod or plunger 45, which movement is transferred to the air piston 44. Such movement is resisted by the pressure of the air contained in the jacket 39 and cylinder 41 of the air accumulator, thereby maintaining the desired pressure between the rolls of the mill. Due to the large volumetric capacity of the jacket of the accumulator, the pressure of the air therein will be varied but slightly under the normal operating range of the device. Any leakage in the air system will immediately be replenished by air from the air storage tank, thus maintaining the desired, predetermined pressure within the air accumulator. The pressure within the air accumulator and the relative sizes of the air piston 44, plunger 45, and housing cylinders, is so proportioned as to produce the proper amount of pressure upon the material passing between the rolls 15 and 16.

It frequently happens that pieces of iron or other inflexible foreign substances are fed to the rolls with the sugar cane, and in such cases it is highly desirable that the pressure between the rolls be promptly released. This can be done with our device because of the provision of the emergency release valve 13 which, as hereinbefore stated, is connected either to the single unit shown or to a battery of units. This emergency release valve may be placed in any suitable position and preferably at such place where the operator can see the action of the rolls of all the mills. When it is necessary to release pressure on the rolls of the mills, the emergency release valve 13 is actuated which allows air, under storage tank pressure, to pass through the piping 79 to the interior of the casings of the pressure regulating and shut-off valve 62 and air relief valve 64. Such air, coming into the casings of these valves will, through the pipes 73 and 78, be brought to bear against the under side of each of the diaphragms 70 and 75, causing the plugs 72 and 77, respectively, to be actuated. In the case of the pressure regulating and shut-off valve 62, such actuation will cause the plug 72 thereof to close, thus shutting off further supply of the air from the tank through the pipe 60. In the case of the air relief valve 64, upward movement of the diaphragm will cause the plug 77 thereof to be opened. When the plug 72 of the pressure regulating valve 62 is closed, and the plug 77 of the air relief valve 64 is opened, air contained within the air accumulator and within the pipe 61 will be permitted to escape to the atmosphere through the pipe 81, thus quickly relieving the pressure within the air system and also within the oil system, allowing the rolls 15 and 16 to easily separate, thus permitting the foreign matter to pass therebetween without injury to the rolls or other parts of the mill.

Obviously, some modifications of the details herein shown and described may be made without departing from the spirit of our invention or the scope of the appended claims, and we do not, therefore, wish to be limited to the exact embodiment herein shown and described, the form shown being merely a preferred embodiment thereof.

Having thus described our invention, what we claim is:

1. In a sugar cane mill having stationary and movable bearing blocks, the combination with the movable bearing blocks thereof, of an independent, stationarily-arranged housing cylinder for each block, a movable piston in each housing cylinder cooperating with said block, and an independent hydraulic accumulator, said accumulator comprising two stationary cylinders, a piston for each of said accumulator cylinders, said accumulator pistons being coactively engaged when producing pressure, said accumulator cylinders having bores of different diameters, the smaller accumulator cylinder being connected to the housing cylinder in a closed oil system, the larger accumulator cylinder being connected in a separate, closed air system and having its piston acted upon by the pressure of the air in the air system, whereby the application of air pressure of predetermined amount on the larger cylinder will produce an application of greater pressure to the mill bearing blocks by means of the piston in the smaller cylinder, an air pipe connecting a suitable source of air supply with the air cylinder of the accumulator, a pneumatically-operated shut-off valve in said pipe, a branch pipe connected in said air pipe and having one end thereof open to the atmosphere, a pneumatically-operated air relief valve connected in said branch pipe, and emergency means connected in said air

system to control the closing of said shut-off valve and the opening of said air relief valve, whereby pressure upon the piston of the housing cylinder may be instantly removed by release of pressure within said air system.

2. In a sugar cane mill having stationary and movable bearing blocks, the combination with the movable bearing blocks thereof, of an independent stationarily-arranged housing cylinder for each block, a movable piston in each housing cylinder cooperating with said block, and an independent hydraulic accumulator, said accumulator comprising two stationary cylinders, a piston for each of said accumulator cylinders, said accumulator pistons being coactively engaged when producing pressure, said accumulator cylinders having bores of different diameters, the smaller accumulator cylinder being connected to the housing cylinders in a closed oil system, the larger accumulator cylinder being connected in a separate, closed air system and having its piston acted upon by the pressure of the air in the air system, whereby the application of air pressure of predetermined amount on the larger cylinder will produce an application of greater pressure to the mill bearing blocks by means of the piston in the smaller cylinder, an air pipe connecting a suitable source of air supply with the air cylinder of the accumulator, a pneumatically-operated shut-off valve in said pipe, a branch pipe connected in said air pipe and having one end thereof open to the atmosphere, a pneumatically-operated air relief valve in said branch pipe, each valve having a diaphragm chamber, an air pipe line connecting said source of air supply with the diaphragm chambers of said shut-off valve and said relief valve, and a manually-actuated emergency relief valve connected in said air pipe line for controlling the supply of air to the diaphragm chambers of the shut-off and relief valves, whereby the supply of air from the air storage tank is shut off and pressure upon the pistons of the housing cylinders is instantly removed by release of pressure within said air system through said relief valve.

3. In a sugar cane mill, the combination with an air supply tank, of a hydraulic accumulator, comprising two stationary cylinders, a piston for each of said accumulator cylinders, said accumulator pistons being coactively engaged when producing pressure, one of said accumulator cylinders being connected to the housing cylinders in a closed oil system, the other of said accumulator cylinders being connected in a separate, closed air system, an air pipe connecting said air tank with the air cylinder of said accumulator, a shut-off valve in said pipe, a branch pipe connected in said air pipe and having one end thereof open to the atmosphere, an air relief valve connected in said branch pipe, said supply tank having greater pressure and volumetric capacity than that of the air cylinder of the accumulator for immediately replenishing air losses from the air cylinder of the accumulator, and manual means mechanically interconnected for simultaneously closing said shut-off valve and opening said relief valve, whereby pressure upon the pistons of the housing cylinders may be instantly removed by release of pressure within said air system.

4. In a sugar cane mill having stationary and movable bearing blocks, the combination with the movable bearing blocks thereof of an independent, stationarily-arranged housing cylinder for each block, a movable piston in each housing cylinder cooperating with said block, an air supply tank, an independent hydraulic accumulator, said accumulator comprising two stationary cylinders, a piston for each of said accumulator cylinders, said accumulator pistons being coactively engaged when producing pressure, said accumulator cylinders having bores of different diameters, the smaller accumulator cylinder being connected to the housing cylinders in a closed oil system, the larger accumulator cylinder being connected in a separate, closed air system and having its piston acted upon by the pressure of the air in the air system, whereby the application of air pressure of predetermined amount in the larger accumulator cylinder will produce an application of greater pressure to the mill bearing blocks by means of the piston in the smaller cylinder, an air supply pipe connecting said air tank with the air cylinder of said accumulator, a pneumatically-operated shut-off valve in said supply pipe, a branch pipe connected in said air supply pipe and having one end thereof open to the atmosphere, a pneumatically-operated air relief valve connected in said branch pipe, each valve having a diaphragm chamber, an air line connecting the air supply tank with the diaphragm chamber of said shut-off valve and said relief valve, said supply tank having a greater pressure and volumetric capacity than that of the air cylinder of said accumulator for immediately replenishing air losses from the air cylinder of said accumulator, and manually-actuated emergency means connected in said air line to control the closing of said shut-off valve and the opening of said relief valve, whereby pressure upon the pistons of the housing cylinders may be instantly removed by release of pressure within said air system.

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