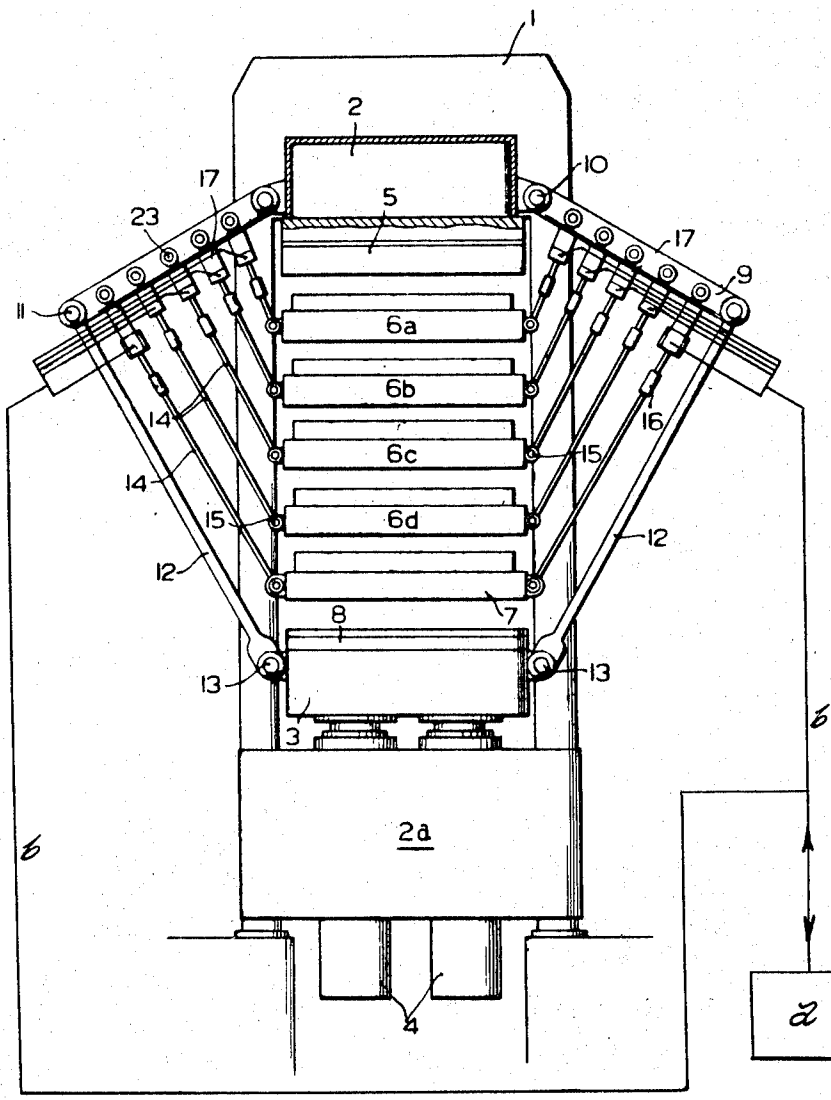
June 24, 1969 W. HÜTTER 3,451,334

MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

Filed Sept. 26. 1966 Sheet 1 of 5

FIG. 1a



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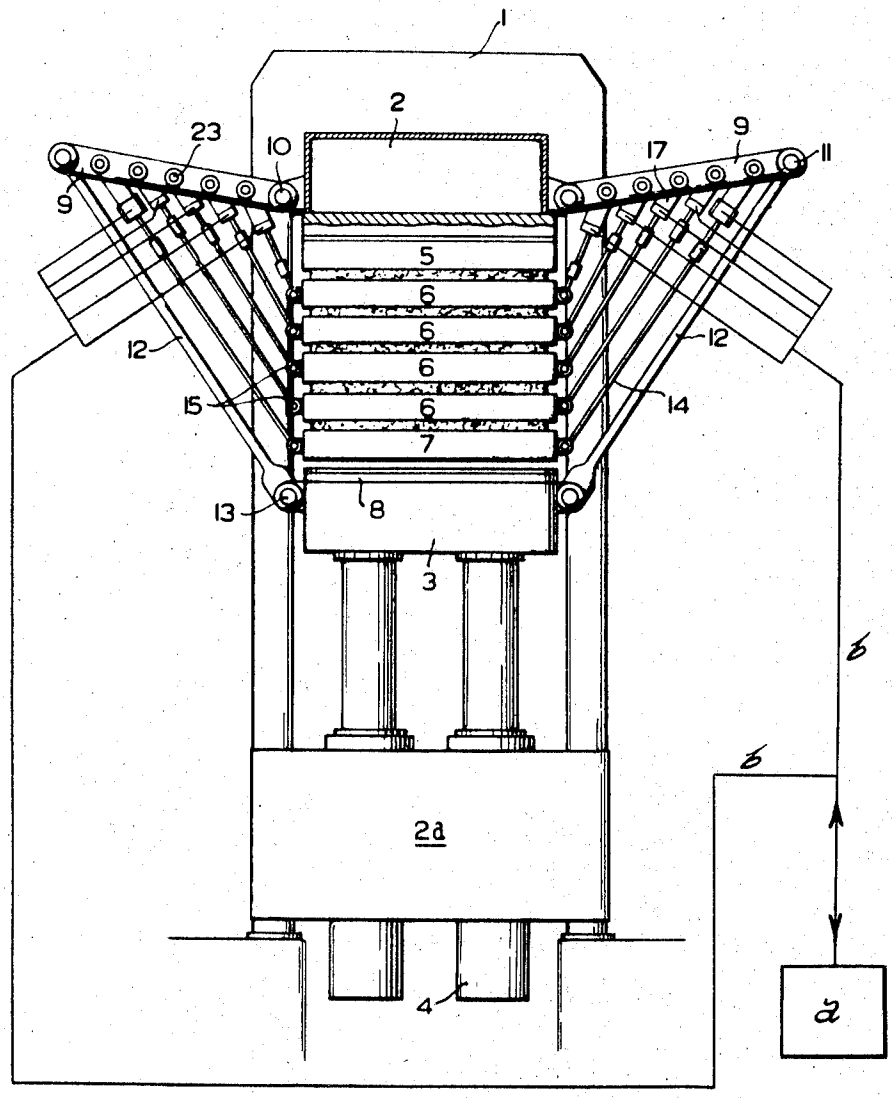
Attorney

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MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

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FIG. 1b



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MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

FIG. 2

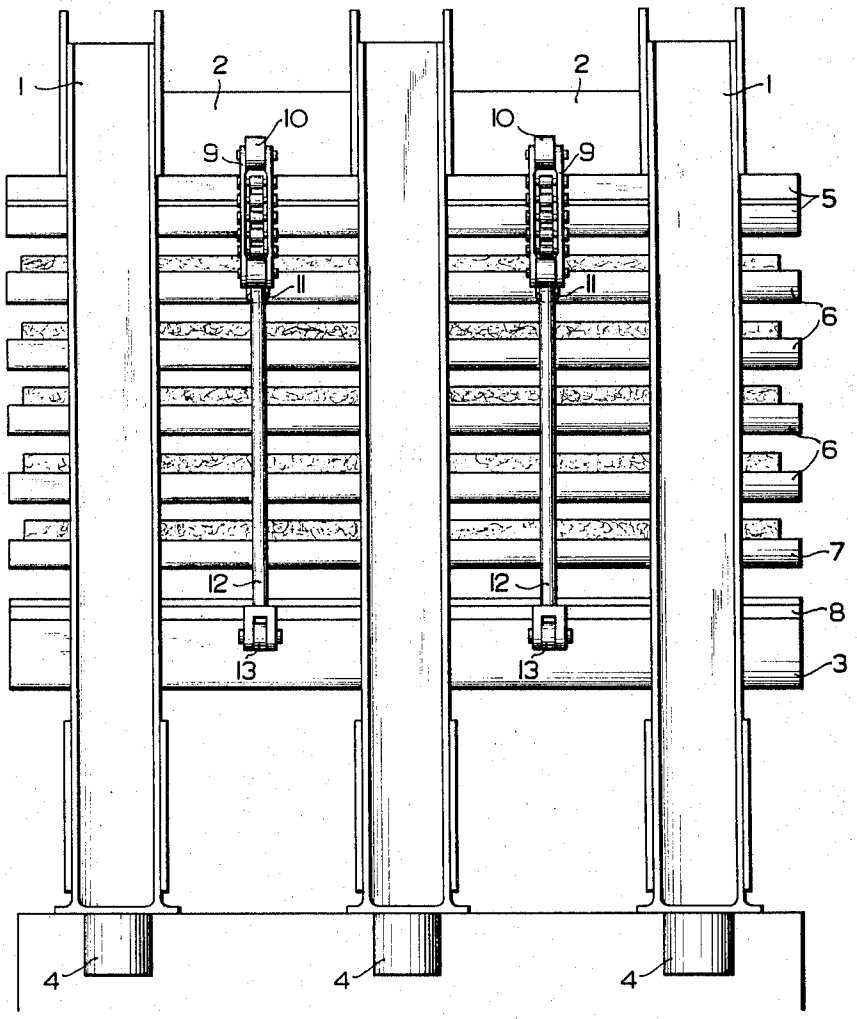
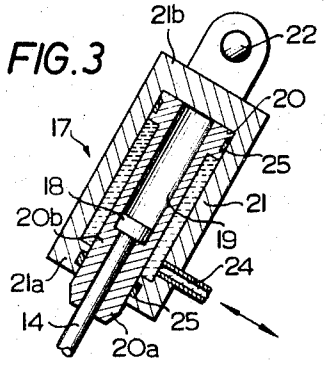


FIG. 3



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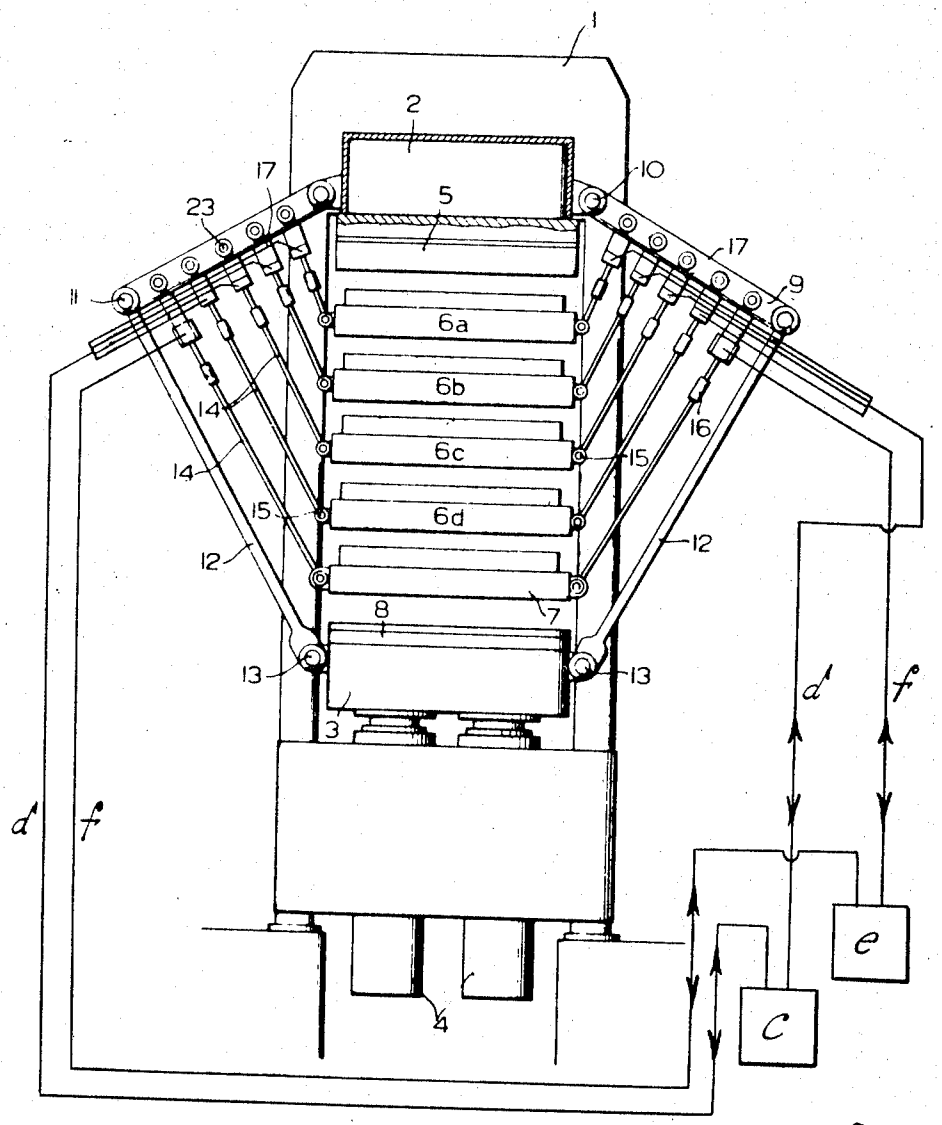
by Jacob L. Collins

June 24, 1969 W. HÜTTER 3,451,334

MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

Filed Sept. 26, 1966 Sheet 4 of 5

FIG. 4



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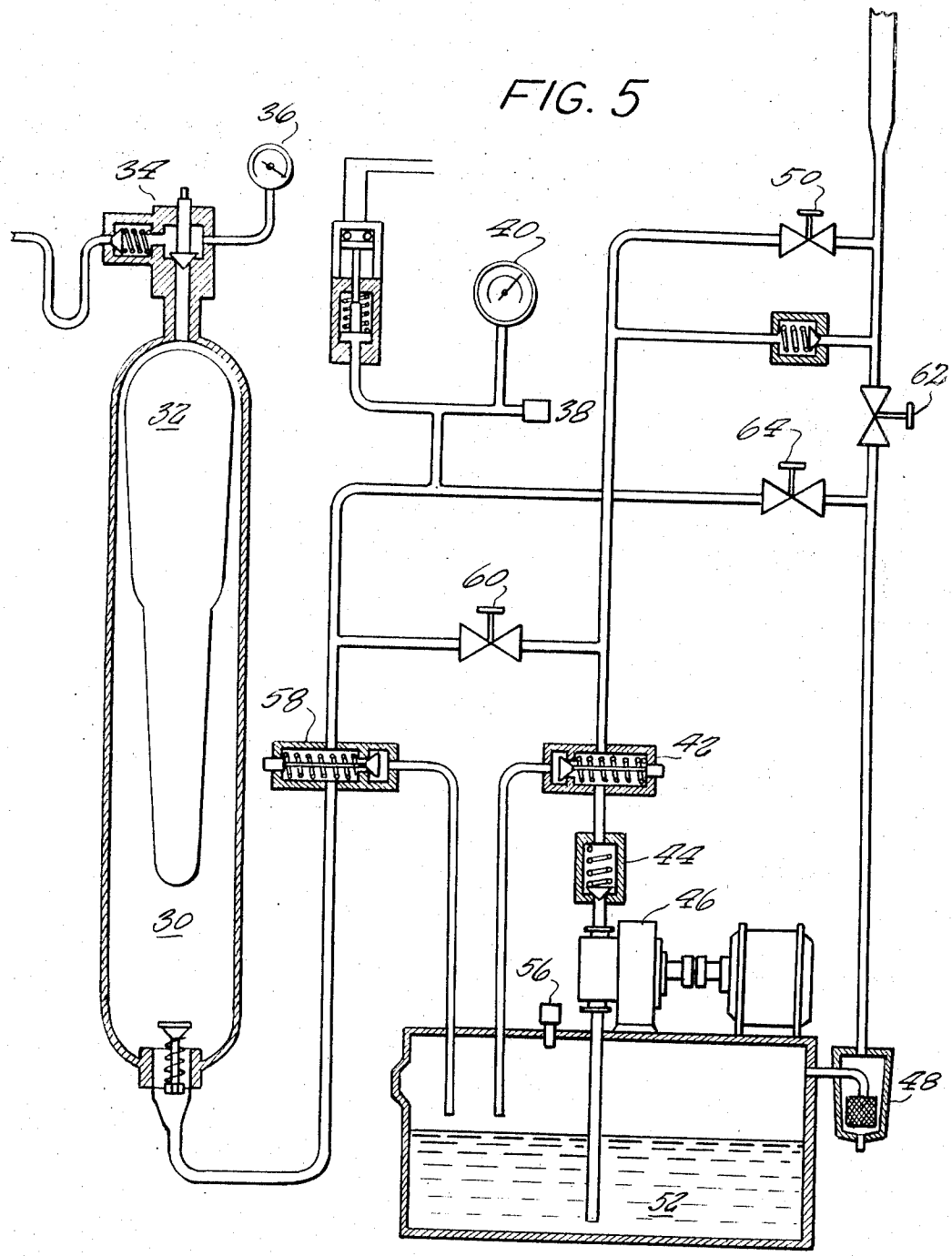
Attorney

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MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

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FIG. 5



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3,451,334

MULTI-TIER PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING TIERS

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Continuation-in-part of application Ser. No. 436,866, Mar. 3, 1965. This application Sept. 26, 1966, Ser. No. 582,047

Int. Cl. B30b 7/02

U.S. Cl. 100—200 4 Claims

ABSTRACT OF THE DISCLOSURE

The press has several vertically displaceable platens arranged in a single row, between the press table and a top cross-bar. An arm is pivoted on each end of the cross-bar. Adjustable pairs of pull rods connect pivotably each platen to the respective arms. The pull rods each have hydraulic cylinders for equalizing the pressure on the respective platens.

The present application is a continuation-in-part of U.S. patent application Ser. No. 436,866 filed on Mar. 3, 1965, by the same applicant, now abandoned.

The invention relates to a multi-tier press with simultaneously opening and closing tiers.

The related industry has developed many different designs for the simultaneous closing and opening of all the tiers of a multi-tier press mechanism. In these mechanisms, that construction proved most successful wherein on two oppositely disposed sides of the press there are mounted arms swingable about a horizontal axis and pressure rods secured to the press table and linked to the free end of the respective swingable arms, while the individual tier platens are connected by links to the swingable arms. The links or pull levers at the same time extend in succession downwardly in proportionally reduced lengths, corresponding to the tier platens from the pivot axes of the respective swinging arms.

In order to adjust the individual pull members to the required lengths between the linking points to the corresponding tier platens and the swinging arm there are usually provided tension locks or swivels or a similarly acting retightening device for each member or for each pair of members. After the ensuing adjustment of the pull members to their required lengths, the mechanism operates without difficulty when all the tiers are loaded to exactly the same heights.

In practical application, however, this is not the case. Furthermore it must always be taken in consideration that each press plate occasionally has a too high or too low a charge or may be left empty through an oversight.

In order to overcome the difficulties resulting from an unequal filling of the press plates it has already been proposed to equip the above pull members between the plates and corresponding swinging arms with an hydraulic equalizing device. For this purpose the pivot point of each pull member was constructed as a double acting hydraulic cylinder, in which a piston-like enlarged upper end could displace a rodlike pull lever. According to the known proposal, the space in the cylinder under the piston end was filled with a liquid or refined medium which acted as a hydraulic cushion. The plate suspended at the piston end of each pull member acts as a counterweight and pulls the piston end downward until the counter pressure reaching the hydraulic cushion equalizes this weight pressure. In order to attain the intended equalizing effect each piston end is provided with two bores, one

of which is closed by an adjustable relief valve and the other of similarly adjustable return check valve.

The proper installation or adjustment of all relief and check valves, according to the known proposal, requires much time and experience. Furthermore, the individual equalizing mechanism of the pull members must be watched because the relief or check valves lose their seals and the intended equalizing effect is lost.

The invention obviates these disadvantages. Its purpose is to change the hydraulic equalization mechanisms of the pull members both with regard to construction and function and to completely dispense with relief and check valves at the piston-like enlarged upper ends of the pull members, as well as with the corresponding bores through the piston end. The solution of this purpose according to the invention resides substantially in the following:

The invention comprises a hydraulic cylinder for each pull member or, more precisely stated, for the equalizing mechanism of the corresponding swinging arm. According to the invention, however, this cylinder is impacted only in the direction of the swinging arm by a hydraulic pressure medium and is provided with a hollow piston connected with the pull member and provided with a downwardly extending bush for a piston-like enlarged end of the pull member, said end having no bore therethrough. At the point of transition of its upper bush-like part into the lower part each hollow piston is provided with a shoulder on which normally rests the piston-shaped enlarged end of the respective pull member. The "fill" of the cylinder is calculated in such a manner that the hollow piston bears with its end directly on the open end wall of the cylinder as long as the hydraulic cushion under it is not compressed by the weight pressure of the corresponding plate.

Further details of the invention and of the manner of its operation are described in the embodiment examples shown in the accompanying drawing. The drawing illustrates a multiplate press of the above mentioned type of construction with a mechanism for the simultaneous closing and opening of all plates wherein each plate is provided with a pull member and hydraulic equalizing device.

In the drawing:

FIG. 1*a* is a side elevational view, partly in section, of the press, showing the press in open position and a schematic representation of a single common accumulator and the connections thereto; FIG. 1*b* is a side elevational view, partly in section, showing the press of FIG. 1*a* in partly closed position.

FIG. 2 is a side elevational view, on an enlarged scale partly in section, of the press in open position and

FIG. 3 is a cross-sectional detail of the working cylinder of the equalizing device.

FIG. 4 is a view similar to FIG. 1*a*, with the employment of two accumulators, and

FIG. 5 shows, schematically, an accumulator.

In the illustrated multi-platen press, the upper crossbar **2** is rigidly secured to the frame **1** mounted on the press base **2***a* and the lower crossbar is constructed as a press table **3**, which may be raised and lowered, while respective hydraulic cylinders **4** are provided for the upwardly directed movement of the press table **3** and its downward return when the press is opened. The numerals **5**, **6***a*, **6***b*, etc. and **7** indicate the cover plates of the individual press plates in the direction from the top to bottom. The drawing indicates only six plates for the sake of clarity, while in actual use twenty and more plates may be present. The cover plate **5** of the upper story and the bottom plate **8** of the lowest story are rigidly secured to the upper cross-beam **2** and to the press table **3** respectively. The cross-bar **2** is provided at each side with two

fork-like arms **9** which are swingable about a horizontal axle **10**. Rigid pressure rods **12** extend from the free ends of each of the swinging arms **9**, the lower ends of these rods being secured to the press table at **13** and the upper ends at **11**. In order to hold and raise the plates **6***a*–**6***b* and **7**, which may be mounted in known manner on the frame support **1**, there are provided pull members in the form of rods **14**, which are linked at **15** to the corresponding story plates of the corresponding stories.

Each rod **14** is provided with a turnbuckle, tension lock **16** or the like, by means of which it is possible to make a precise adjustment of the length of equalizing devices indicated by the numeral **17** pivoted to arms **9** at **23**. The enlarged piston-like end **18** of each rod **14** is guided in a bush-like opening **19** of a piston **20**, as shown in FIG. 3. The piston **20** is displaceable in a cylinder **21** and is provided with a rod **14** which is guided in the lower part **20***a* of the lower end **21***a* of cylinder **21**. An eye **22** is provided at the upper end wall **21***b*, by means of which eye the cylinder **21** and thereby the hollow piston **20** and the rod **14** connected with its piston end **18** is connected to one of the respective swinging arms **9**, as shown in FIG. 1.

At the point where its hollow portion **19** changes from its bush-like upper portion to a lower portion for guiding the corresponding rod **14**, the hollow piston **20** is provided with a shoulder **20***b* on which normally abuts a piston-like enlarged top end **18** of the rod **14**. The work space of the cylinder **21** which is left free between the piston **20** and cylinder **21** is impacted with a hydraulic pressure medium through the nipple **24** in the direction of one of the respective swinging arms **9**, thus acting on the piston **20**. The hydraulic pressure medium may enter either upwardly into the space between the cylinders **21** and **20***b* or be discharged downwardly in the space through the nipple **24**.

The free circular-shaped work space which is connected to the nipple **24** and is left free by the piston **20** is sealed off by the sealing rings **25**. This prevents the pressure fluid from entering the piston hollow **19**, in which the rod **14** with its upper end **18** is freely displaceable. There is therefore no pressure liquid in the hollow **19**, which could influence the upper end **18** of the rod **14**. Furthermore, the lowest of the sealing rings **25** prevents the escape of the pressure liquid from the work space into the atmosphere. The nipple **24** is closed off by the upper piston end **20** when the latter rests on the end wall **21***a*.

The effect of the above described equalizing devices **17** depends on the amount of pressure with which the hydraulic fluid is introduced through the nipples **24** into or maintained in the work space between the cylinders **21** and pistons **20**.

As noted above, difficulties in operation are caused by the unequal filling of the individual press tiers.

Should the pull members **14** be of rigid construction, without an equalization device as in the prior art they would bend or be torn apart.

The equalizing devices **17** are therefore provided to shorten or lengthen the pull members according to the particular loads.

All equalizing devices are functionally the same. The pressure of the hydraulic medium in all these devices is calculated in such a manner, that the force acting on the pistons **20** is somewhat greater than the weight of the platens **6***a*–**6***d*, **7**, including the filling of the material to be pressed and the rods **14** and links **15**. The equalizing devices thus obtain, the position in FIG. 3, with the hollow pistons **20** abutting the upper cylinder wall **21***b*, when the press is opened.

Should now one tier be filled too high with material, this material will contact the next higher tier sooner than anticipated. This next higher tier or platen will be raised, while the platen below has a heavier load. The rise of the upper plate requires a shortening of the corresponding pull member **14**. This is effected by the upward movement of the pull member in the hollow **19**.

The overload of the lower platen and its corresponding load height can be equalized by having the rods **14** pull the hollow cylinders **20** downward, thus lengthening the pull members. Obviosuly, the load on the lower platen will be greater than the force of the pressure medium acting on the piston **20**.

In this manner an equalization is atuomatically effected, so that the press functions without difficulty and no bending or breaking of the pull members will take place.

In one construction, all the equalizing devices may be of the same dimensions. It is thus possible to connect all devices to a common pressure regulating device. Due to the equal size of these devices, the force acting on each of the pistons **20** is the same.

FIG. 1*a* illustrates schematically a regulating arrangement with devices **17** and devices **17**. An accumulator *a* is connected by means of conduits *b* to the equalizing devices so that this pressure prevails in both devices.

It is also possible, if desired to attain an equal force in equalizing devices of different sizes. In this case however, each device must be impacted with a correspondingly different pressure.

A particularly advantageous action of the press results, however, when the equalizing devices **17** are controlled in such a manner that the pressure medium force acting upon the piston **20**, is substantially greater than the total sum of the weight of the platen, the material, the bar **14** and the link **15**, as in the rest of the devices. Furthermore the lowest press tier should be left empty, as shown in the example.

A greater force acting on the pistons **20** of the equalizing devices **17** can be produced by connecting all equalizing devices to one common control member, while making the devices **17** of larger dimensions. Since the force of the pressure medium acts upon a larger piston surface, the resulting force is much greater.

On the other hand, the devices **17** may be connected to a separate hydraulic pressure medium accumulator, as shown in FIG. 4.

All devices **17** are connected to an accumulator *c* by conduits *d*, while devices **17** are connected to an accumulator *e* by conduits *f*. Since the accumulators may be regulated for a certain pressure, the devices **17** may be controlled independently of one another.

As shown schematically in FIG. 5, each of such accumulators comprises a massive housing **30** for the pressure medium in which is secured a so-called "storage nozzle" **32** filled with nitrogen. The oil accumulators are connected with the equalizing cylinders **17** through the conduits *d* and *f* respectively and forms a closed hydraulic circuit. Since the gaseous nitrogen in the "storage nozzle" **32** is compressible, it is possible to preset a certain pressure in the accumulators, depending on the quantity of the nitrogen fill, whereby said pressure may further compress the pressure liquid flowing in from the equalizing devices **17**. It is therefore possible to adjust the pressure with such exactness, that the pressure exerted on the pull members **14** and **14'**, during the closing operation of the press, suffices to pull the pistons **20** downwardly by the displacement of the pressure fluid. The displaced fluid then flows back into the oil accumulator under compression by storage nozzle **32**. Should the pistons **20** be relieved to such an extent that the pressure force exerted thereon by the hydraulic pressure medium is greater than the pulling force acting on the pull members **14**, then the pressure medium will flow again to the equalizing devices **17** through the release of pressure of the "storage nozzle" **32**.

FIG. 5 further shows schematically the details of construction and the connections of the accumulators to the equalizing devices. Numeral **34** indicates a filling device, **36** is a pressure gage, **38** is a connection for testing, **40** is a manometer, **42** is a pressure limit valve, **44** is a check valve, **46** is a high pressure hydraulic pump, **48** is a magnetic screen filter, **50** is a ball type stop valve, **52** is the

oil reservoir, **56** is an air filter, **58** is a pressure limit valve, **60** is a ball type stop valve, **62** is another ball stop valve, **64** is yet another ball stop valve.

This press operates as follows:

As usual, all pistons **20** contact the upper end wall **21***b* when the press is open. The closing operation is entirely similar to that of the first described embodiment. As soon, however, as the press has closed sufficiently to seal the fill material the force acting on the pull members **14** and **14'** becomes so strong, that all the pistons **20** are pulled down.

The increased force acting on the pull members **14** is based on the fact that the foot plate **8** of the press table **3** does not yet press from below against the tier plate **7** during this pre-pressing and the pressure force may thus be transferred to cylinder **4**.

Due to the change in length of the pull members, resulting from pulling out of the piston **20**, the footplate **8** of table **3** reaches directly the tier plate **7**, so that now the material may be completely compressed, with the full employment of the press pressure produced in the cylinders **4**.

The advantage of this construction, during closing, resides in the fact that the material is first pre-compressed lightly, while the weight of all tier plates is completely equalized, so that equal press conditions are produced in all tiers.

When the press is opened, the cycle is repeated in reverse order. At first only the press table moves downward, while the filled tiers, still under the lighter pressure of the equalizing devices **17**, remain closed until, due to the lowering of the swinging arms **9**, the hollow cylinders **20** have been moved upward to contact the end walls **21***b*. This somewhat longer closed condition under the lighter pressure of the equalizing devices **17'** is advantageous. For example, in pressing under heat conditions, the resulting steam may continuously evaporate. During a sudden opening, the press plates may be partially broken as a result of an explosion-like action. Additionally the quality of the press plates is considerably better when a press plate is not suddenly completely opened under immediate pressure relief.

It has developed and proven advantageous, particularly for goods of a certain nature to leave empty the lowest press story between the plates **7** and **8**. It has thus been made possible to have the press table **3** act through the pressure rod **12**, the swinging arms **9** and the pull members through the rod **14** on the foot plates or bottom plates **6** or **7** of the remaining press story. It is thus possible to also operate very heavy multi-plates presses with small and exact pressures, which is not possible in comparable known multi-story presses. The following must be observed in this case: In heavy presses the press table is subject to a pressure of 60 *t* and more in order to subject the press material in the individual stories to the required specific surface pressures of, or example 80 kg./cm.^{2}. Contrarywise, machines of a different type require only a very small or very precisely maintained specific surface pressure. The possibilities of the hydraulic drives of known multistory presses do not extend far enough to make possible even a 1% adjustment of the pressure. In the press according to the invention this is accomplished without any difficulty by leaving the lowest press plate empty. The press table **3** is displaced only to such an extent that the loaded plates are closed and the equalizing devices **17** of these plates prevent an uncontrolled precompression of the pressed material. The empty lowest plates, the bottom plate **8** of which may consist of only a cooling plate, remains open an amount equal to the thickness of the pressed goods. Now the swinging arms **9** are moved upwardly due to the corresponding impact of the power equalizing devices **17** with the hydraulic pressure medium somewhat further and take along at the same time all the bottom plates of the filled stories by means of the corresponding rods **14**. The pressure of the mediums in the devices **17** can be conveniently adjusted in fractions of one atmosphere of absolute pressure so that any desired slow and precisely selected specific surface pressures may be obtained in the filled stories. FIG. 1*b*, shows the press after the ensuing compression of the press material while the lowest story limited by plates **7** and **8** is always remaining open a certain distance.

The regulation may be provided by an oil accumulator which may be set for a certain pressure and is shown in FIG. 5. A storage device **32**, for the hydraulic medium is mounted in the massive housing **30** and is filled with nitrogen. The accumulator is connected through the conduits *b*, *d* and *f* with the cylinders **17** and **17'** and forms a closed hydraulic circuit. Since the nitrogen in the storage device **32** is compressible, it is possible to set a certain pressure, depending on the fill amount of nitrogen, which can be further compressed through pressure fluid streaming in from the equalizing devices **17**, **17'** in which pulling force exerted on the rods **14** during the closing of the press suffices to pull downwardly the pistons **20** under the displacement of the pressure liquid. The displaced fluid flows into the accumulator **30** while compressing the storage device **32**. Should the pistons **20** be relieved to such an extent that the pressure exerted on them by the hydraulic fluid is greater than that on the rods **14**, **14'**, then the pressure medium will flow back when the tension of the device **32** is released to the cylinders **17** and **17'**.

As shown in FIGS. 1*a* and 1*b*, the conduits "*b*" are connected to the conduit (in the upper right hand portion of FIG. 5). The conduits "*d*" and "*f*" are likewise connected to the conduit **70**, as are the devices "*c*" and "*e*" in FIG. 4. The conduit "*d*" and "*f*" leading to devices "*b*" and "*e*" may be joined together in the same manner as shown in FIG. 1*a*.

What I claim is:

1. Multi-tier press comprising a frame support, a press base, oppositely spaced vertical frame members extending upwardly of said base, a cross-beam integral with the upper ends of said members having a bottom portion, a horizontal top platen secured to the bottom portion of said cross-beam, a horizontally extending press table vertically displaceable between said frame members, hydraulic power means for displacing said press table, a plurality of horizontally spaced platens displaceable between said top platen and said press table, a pair of arms, each arm pivotable with one of its ends to the respective ends of said cross-beam, a pair of rigid pressure rods, each of said rods pivotably connecting the other ends of said arms with opposite ends of said press table, a plurality of spaced pull members, equalizing means securing the upper ends of said pull members to said arms at spaced intervals, the lower ends of said pull members being pivotable to respective intermediate platens.

2. Multi-tier press comprising a frame support, a press base, oppositely spaced vertical frame members extending upwardly of said base, a cross-beam integral with the upper ends of said members having a bottom portion, a horizontal top platen secured to the bottom portion of said cross-beam, a horizontally extending press table vertically displaceable between said frame members, a hydraulic power means for displacing said press table, a plurality of horizontally spaced platens displaceable between said top platen and said press table, a pair of arms, each arm pivotable with one of its ends to the respective ends of said cross-beam, a pair of rigid pressure rods, each of said rods pivotably connecting the other ends of said arms with opposite ends of said press table, a plurality of spaced pull members, equalizing means securing the upper ends of said pull members to said arms at spaced intervals, the lower ends of said pull members being pivotable to respective intermediate platens, each of said equalizing means comprising a cylinder having a closed upper end portion pivoted to said arms and an open bottom end portion, a hollow piston having an en-

larged portion which is slidable in said cylinder and through said open bottom end portion, said piston having an outer wall spaced from the inner wall of said cylinder and forming a chamber therewith, the upper end of said pull member having an enlaregd piston-like portion slidable in said hollow piston, inlet means for admitting pressure liquid into said cylinder, first seal means for sealing said open bottom end portion with the outer wall of said piston and second seal means in said piston's enlarged end for sealing said enlarged end with the inner wall of said cylinder.

3. Multi-tier press as defined in claim 2, wherein each of said pull members is provided with turnbuckles intermediate said equalizing means and the respective platens for adjusting the lengths of said pull members.

4. Multi-tier press according to claim 2, further provided with a separate pressure accumulator for hydraulic medium supplied to the equalizing means of the pull member connected to the lowermost of said platens and separate pressure accumultor for hydraulic medium supplied to the equalizing means of the pull members connected to the rest of said platens.

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BILLY J. WILHITE, *Primary Examiner.*

U.S. Cl. X.R.

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