Dec. 26, 1967 U. WALCHHÜTTER 3,359,608

FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

Filed March 24, 1964 5 Sheets-Sheet 1

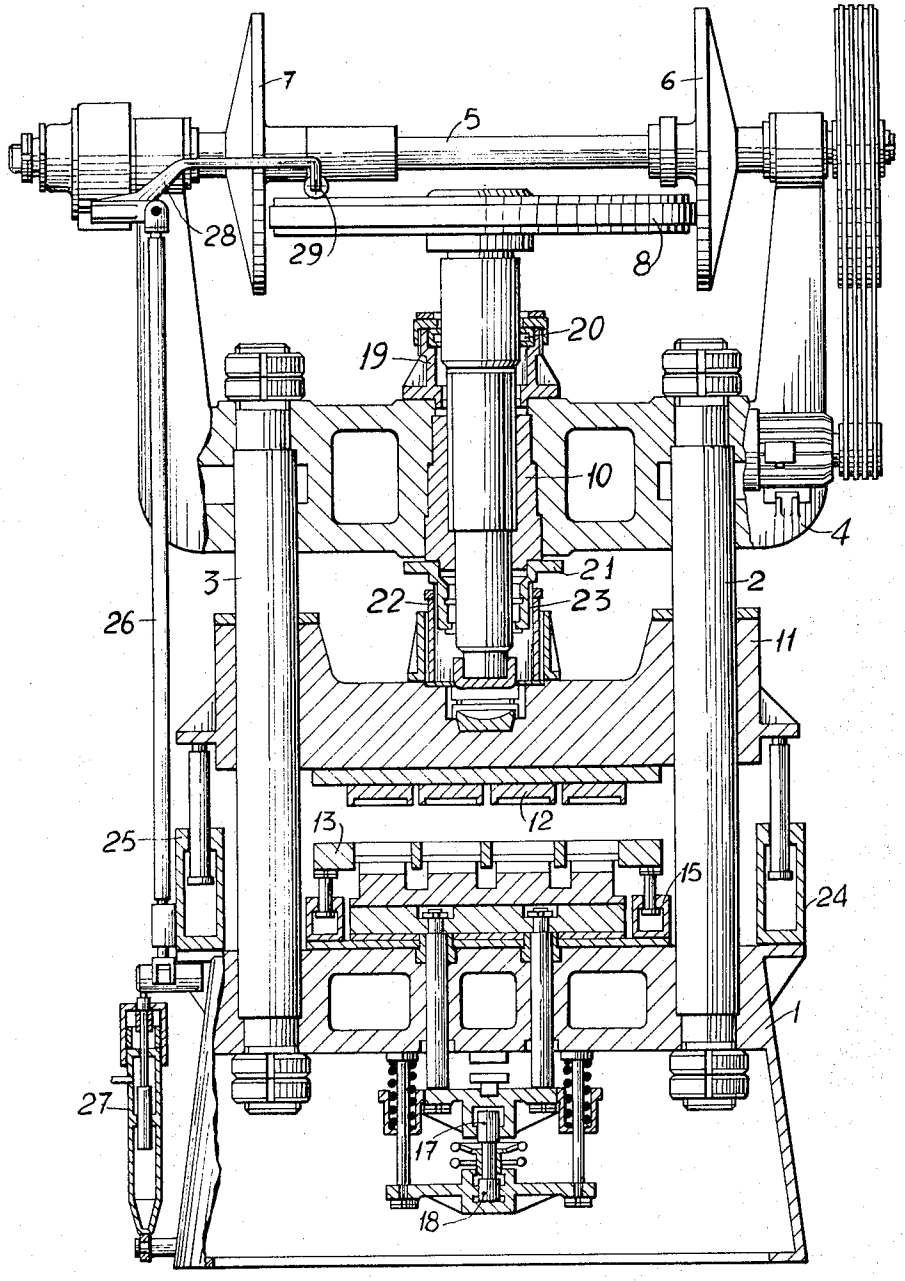

Fig. 1

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FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

Filed March 24, 1964 5 Sheets-Sheet 2

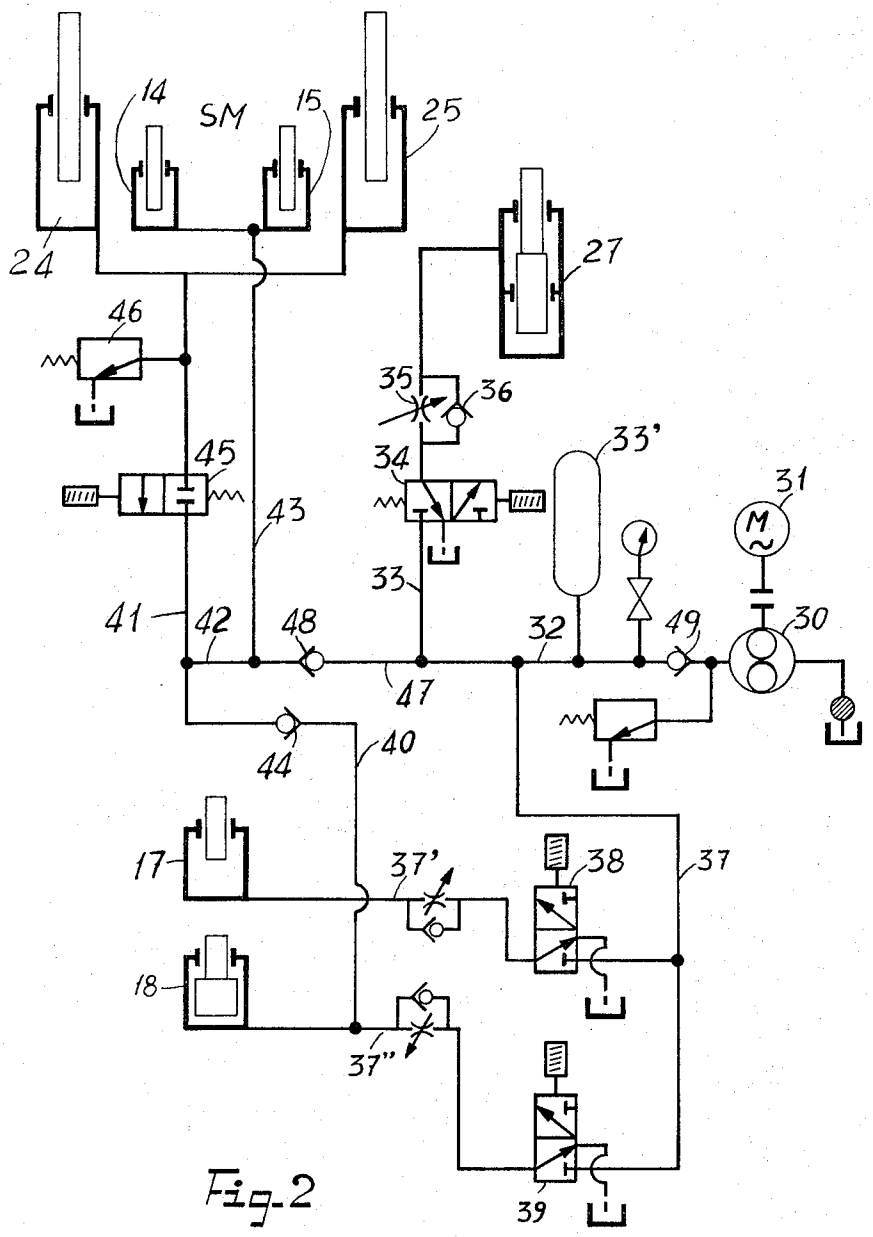

Fig-2

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FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

Filed March 24, 1964 5 Sheets-Sheet 3

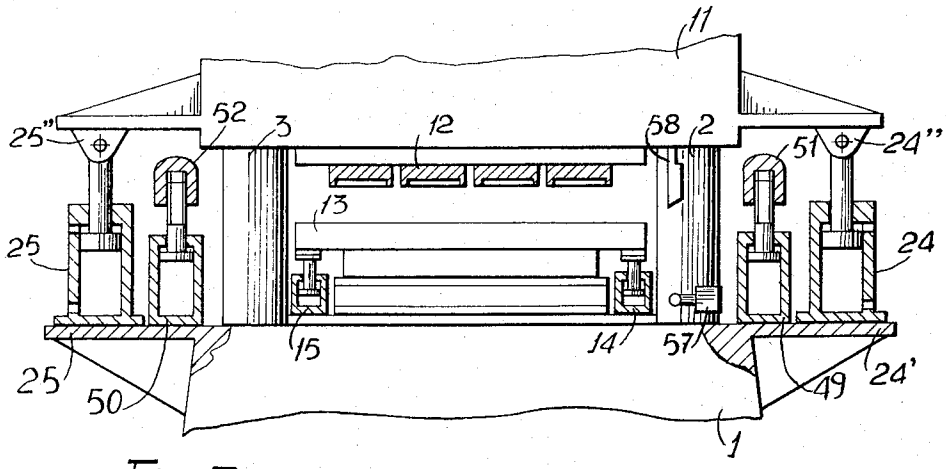

Fig. 3

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FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

Filed March 24, 1964 5 Sheets-Sheet 4

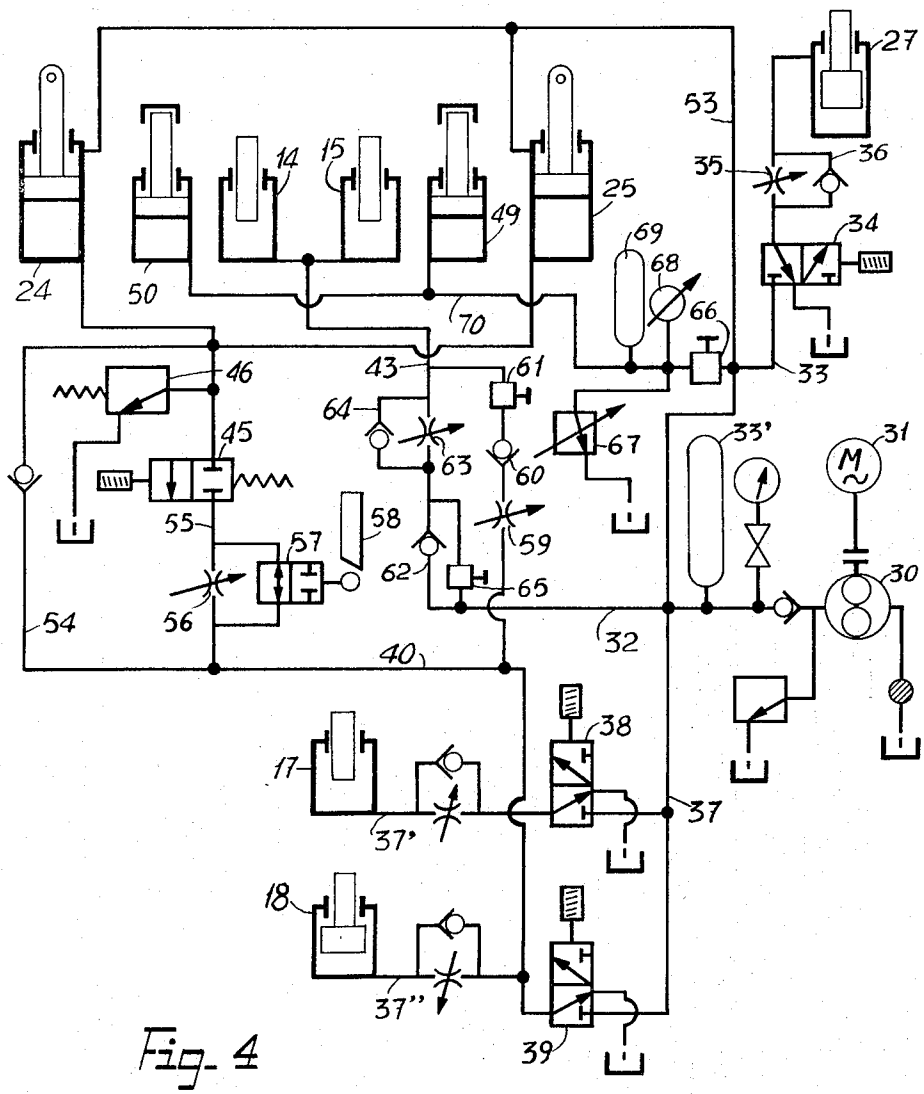

Fig. 4

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FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

Filed March 24, 1964 5 Sheets-Sheet 5

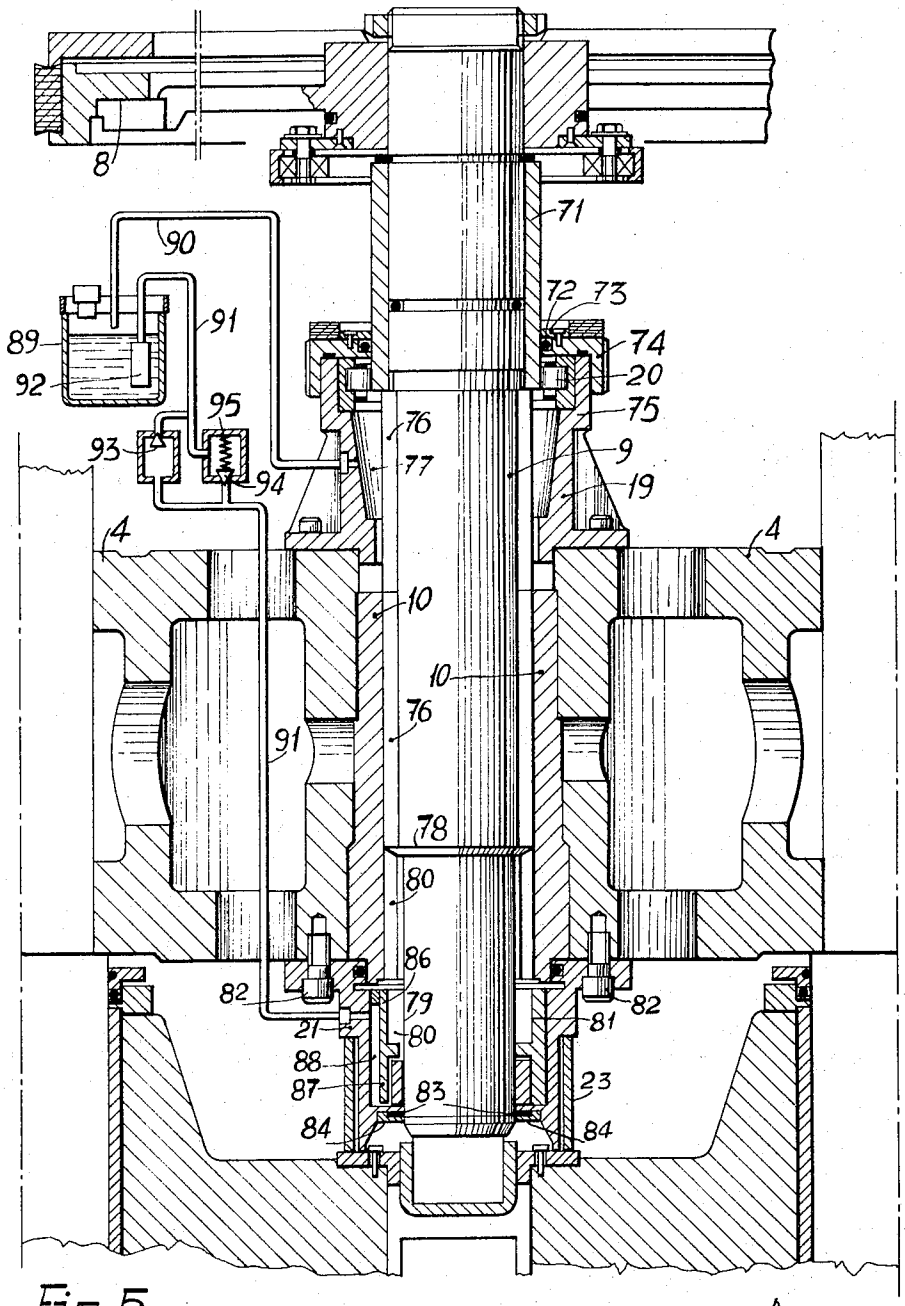

Fig-5

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United States Patent Office 3,359,608
Patented Dec. 26, 1967

3,359,608

FRICTION AND SCREW PRESS FOR THE MANUFACTURE OF CERAMIC ARTICLES

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Filed Mar. 24, 1964, Ser. No. 354,223
Claims priority, application Italy, Mar. 27, 1963, 6,251/63, 6,252/63; Mar. 17, 1964, 5,961/64
13 Claims. (Cl. 25—45)

This invention relates to improvement in friction and screw presses for the manufacture of ceramic articles, as tiles, mosaic tiles and the like ceramic products, said improvements intended to increase the safety, and to avoid some drawbacks observed in existing presses for this purpose.

A first object of this invention is to obtain a means to regulate and preestablish one time for all the hoisting of the mobile traverse.

Another object of this invention is to obtain the elimination of the so called "pastille play" between the mobile traverse and the screw end, which requires a supplementary stroke of the screw, and consequently an increase of the period of time for compressing of the ceramic material.

A further object of this invention is to maintain said mobile traverse independent from the press screw at a position the traverse has reached after its first downwards compression stroke, while said screw is recalled upwards in order to be newly thrown downwards for carrying out the second and strong compressing stroke together with said mobile traverse and their cooperating devices, in order to render the press screw lighter, by relieving it from the weight of the mobile traverse and its accessories, and from the work necessary to move these components, thus facilitating the screwing and unscrewing movements of the press screw.

Still another object of this invention is to eliminate the electromagnet for controlling the disc for the up and down movement of the press screw, and to replace it by a hydraulic jack, thus simplifying all the equipment of the friction press for its automatic operation.

Still a further object of this invention is to control the movement of the mobile traverse of the press by means of hydraulic jacks.

An object of the invention is also to obtain the synchronization of the movements of the several components of the machine by means of a sole hydraulic circuit and by using the combination through said hydraulic circuit of the hydraulic devices respectively controlling the movements of the mobile traverse, of the lower plungers of the molds, the mold matrix and the rotating disc.

It is also an object of this invention to change the conditions and steps of compression of the ceramic material within the molds in the sense to complete the usual pressing operations obtained by means of the press screw by pre-compression steps which are obtained by exerting onto the mobile traverse of the press a pre-compression throw, this independently from the press screw, and by maintaining a certain pressure on the material also in the period of time between the first and the final compression steps, in order to eliminate the air enclosed within the mass of material in the molds, said air being the cause of irregular, often unusable tiles and the like articles, particularly when special ceramic material and the like are used for the manufacture of said tiles.

A further object of this invention is to control the said pressure between the first and the second steps of compression in such a manner as to favor the elimination of the air in accordance with the kind and composition of the mass used for, this variation of pressure to be controlled or reduced until a zero value, f.i. in the case of

material wherein the expelling of the air takes place spontaneously due to the swelling of the material which is due in turn to the pressure of the air within the mass of material to be compressed.

A further object of this invention is to provide for a lubricating system so that the screw and cooperating devices may be forcibly lubricated by making use of the movement of the press screw so that the oil is sucked from an oil container and pressed along the threaded portion of the screw, and exhausted back into the said container.

These and further objects and advantages of the invention will result from the specification hereunder given of the same in an example of embodiment also illustrated on the attached drawings, and of which:

FIGURE 1 is a front view, partially in section of a press according to the invention;

FIGURE 2 shows the hydraulic circuit for controlling said press;

FIGURE 3 represents a view of the mobile traverse sustaining elements, according to a variant of the invention;

FIGURE 4 shows the hydraulic circuit controlling the friction and screw press of FIGURE 3; and

FIGURE 5 illustrates in a larger scale the lubricating system according to the invention.

Referring to FIGURE 1, a friction and screw press is composed as usual of a base plate **1**, two uprights **2** and **3** projecting from the latter and sustaining at their upper ends a fixed traverse or press head **4** provided with two arms turned upwards in order to support a continuously rotating shaft **5** enabled to be alternately shifted in axial direction, said shaft bearing two friction discs or wheels **6** and **7**, the purpose of which is to frictionally move with a left or right hand rotating movement a flywheel **8** fixedly connected to the upper end of the press screw **9** which is moved downwards and upwards within a threaded bushing located in the center portion of the fixed upper press head **4**, so that when one of said friction discs **6** or **7**, frictionally engages the flywheel **8** the screw **9** runs upwards and when the other friction disc **7** or **6** frictionally engages said flywheel **8** said screw **9** runs downwards in order to effect the compression through the mobile traverse **11** and the respective accessories of the mass within the mold or molds, thus converting the kinetic force of the flywheel into a compressing force onto the mobile traverse.

Usually a cycle of compacting operations is composed of two successive compression steps as follows:

A first light compression step in order to let the air contained within the mass to be compressed, that is to say between the elements of said mass to go out, and to distribute the latter conveniently within the mold or molds, and

A second strong or more energetic compression step in order to impart to the article under treatment the necessary compactness and mechanical resistance so that the article may be used for the purpose for which it is manufactured.

The mobile traverse **11** is displaced along both press uprights **2** and **3** and sustains the upper plungers **12** of the molds; this mobile traverse is supported in known similar presses directly at the lower screw end or by means of parallel situated rods in respect of the press screw, said rods being attached to appropriate smaller horizontal controlling rods.

In the known presses, the mobile traverse **11** effects a first compressing step, broadly similar to that of the screw, with the exception of a play left between said mobile traverse and the lower end of the screw, said play being normally called "pastille play" (because it corresponds to the thickness of the article manufactured thereon), and which causes the mobile traverse not to ascend

again after the first compression step has taken place, or, at most, to only go up again for a very small distance, but allowing the screw to run during the upwards stroke and the beginning of the final compression step to move in upwards direction a distance equal to said pastille play, thus producing on said screw a supplementary load which corresponds to the weight of the mobile traverse **11** plus the necessary force to move the latter.

The mold used, at least in the present embodiment of FIGURE 1, pertains to the type molds in which the matrix **13** may be displaced downwards and sustained by means of at least two hydraulic jacks **14** and **15**, by taking account that the plungers **12** have dimensions which are larger than those of the corresponding mold cavities.

In this mold type, the lower plungers or bottom plates **16** are moved by a hydraulic device comprising two in series inserted hydraulic jacks **17** and **18**, as schematically shown in FIGURE 1.

According to this invention, the screw extends at its upper end through a cup-shaped member **19** fastened to the fixed traverse **4** and the upper part of press screw is engaged by bearings **20** of appropriate make carried by cap **19**, while its lower part extends through a second cup-shaped member **21**, and is engaged by bearings **22** carried by the second cap **21**, whereby the screw is properly guided.

A bushing **23** is screwed on the caps **21**, and is set once for all to maintain its lower edge which serves as stopping member for the upward movement of the mobile traverse **11** at a selected elevation.

Still in accordance with this invention, the mobile traverse **11** is made mechanically independent from the press screw **9**, and is bilaterally sustained by hydraulic jacks **24** and **25**, respectively.

Said hydraulic jacks have the task to recall said mobile traverse **11** upwards after each compression stroke, and to maintain it at its upper position until the press screw **9** will move downwards and move said mobile traverse in the same direction, by overcoming the fluid pressure (as there will be explained further hereinafter) within the hydraulic jacks **24** and **25**; the latter have also the purpose to stop the mobile traverse at its lower position as the second compression step takes place, this importing a raising and descending step of the screw.

Still in accordance with this invention, the control of the shaft **5**, which bears the friction discs or wheels **6** and **7**, driving the screw rotation flywheel **8** takes place by means of the hydraulic jack **27**, through the transmission rod **26**, and of its leverage, the purpose of which being to replace the usual electromagnet used in combination with said rod **26**, this with the view to simplify the electric or electronic equipment for the automatic operation of the press, whereby an advantage is obtained in the sense that all the protection and controlling devices for said electromagnet are rendered superfluous and consequently abolished.

Of course, in accordance with the purpose to avoid the aforesaid "pastille play," all usual dead movements of the press and the corresponding intervals of time, which are otherwise indispensable therebetween, are wholly avoided. Furthermore, the existing possibility to hoist the mobile traverse to a constant level permits to simplify the location of all cleaning devices for maintaining the mold or molds in perfect conditions of cleanliness, in particular in the case of the upper mold plungers or covering plates; f.i. by using a rotatory brush for such cleaning, it is possible to locate said brush at an exact elevation, thus avoiding all suspended or suspending flexible or elastic means, which were required in the past, and constituting a complicated and costly equipment for the filling carriage of the press molds.

A set of levers for the rod **26** is intended to act in combination with an arm **28**, which is bent in such manner as to extend over the friction disc **7** with the purpose to control the downwards stroke of the screw, this serving to contact the flywheel **8** and following its movements through a small roller **29**, said arm being lifted together with the flywheel during the second upwards stroke of the latter in order to control the leverage which in turn controls the rod **26** in order to ensure the exact positioning of the friction disc **7** with respect to the flywheel **8** in order to brake and stop it at the required level. There is thus provided a safety member with the purpose to mechanically brake said flywheel at the end of each one cycle of operations, and furthermore to control the means for the automatic operation of the press.

FIGURE 2 shows the hydraulic equipment, with which the press of FIGURE 1 is provided. The hydraulic equipment is constructed to ensure a cooperation of all these hydraulic devices or hydraulic jacks which are necessary to control the friction-screw press in accordance with this invention.

Said hydraulic equipment comprises a high pressure pumping set, composed of the pump **30** and the electric motor **31**; said pumping set supplies the fluid under pressure to a conduit **32**, cooperating with a hydraulic compensator **33'**. Conduit **32** is divided into a first conduit **33** to feed the hydraulic jack **27** for controlling the two friction disc **6** and **7** bearing shaft **5**, said feeding taking place through an electromagnetic valve **34**, which, when turned to one direction, allows the fluid under pressure to reach and invest the hydraulic jack **27**, while, when turned to the opposite direction, allows exhausting of the fluid therefrom. Downstream of the electromagnetic valve **34**, still in said conduit **33** a throttle valve is inserted, which has a regulatable passage, and a check valve **36** in parallel to the throttle valve, the first one used to control the inlet stream speed of the fluid under pressure into the cylinder of the hydraulic jack **27**, and the second to permit a quick exhausing of the fluid.

The high pressure conduit **32** is further divided into a conduit **37** which is in turn divided into two conduits, the one **37'** being intercepted by an electromagnetic valve **38**, and the other **37''** being intercepted by an electromagnetic valve **39**.

The electromagnetic valve **38** controls feeding of pressure fluid into the hydraulic jack **17** in order to control the lifting device of the lower mold plungers or covering plates, or the exhausting of said jack. The electromagnetic valve **39** permits feeding of pressure fluid into the hydraulic jack **18**, and in turn its exhausting valve **39** permits at the same time feeding of pressure fluid, through conduits **40**, **41**, **42** and **43**, into hydraulic jack **24** or **25**, the one or the other sustaining the mobile traverse **11** of the press, and into hydraulic jack **14** or **15**, the one or the other sustaining the mold matrix. Conduit **40** is intercepted by a non-return valve **44** which impedes the return of the fluid under pressure to the conduit **37''**.

Conduit **41** is intercepted by an electromagnetic valve **45** serving to control the opening and closing of a valve **46** used for establishing the maximum pressure checked in order to ensure the communication with the exhaust exclusively when said valve is put under a larger pressure than necessary for operation of the press in question. The usual operation pressure of the press being about 100 atm. (about 13,750 lbs. p.s.i.), said valve will be set for 600 atm. (about 82,500 lbs. p.s.i.).

Conduits **41** and **43** communicate with the high pressure conduit **32** through a conduit **47** which is intercepted by a nonreturn valve **48** permitting the arrival of the high pressure fluid into the high pressure conduit **32** without any possibility of return.

The above described arrangement will result that the upwards stroke of the lower plungers of the molds, under the intervening of the hydraulic jacks **17** and **18**, of the matrix, under the intervening of the hydraulic jacks **14** and **18**, and of the mobile traverse **11**, under the intervening of the hydraulic jacks **24** and **25**, can take place in the same time, so that once the second step of the compacting of the ceramic mass has been carried out,

and while the press screw begins its upwards stroke, all the lower mold plungers **16**, the matrix and the mobile traverse **11** also are brought back to their upper position, so that the tiles are still subjected to compression. Thus the matrix will stop as first, while the lower plungers and the said mobile traverse, still continuing to press the tiles, will move further upwards at the same speed as the screw, contrasting the hydraulic jacks until the lower plungers will reach the same level as the matrix during the extraction of the tiles from their mold cavities, then stopping at this position reached. Finally, the mobile traverse will continue along its upwards stroke to finally stop on abutting against the bushing **23**.

The advantage of this form of extraction is that the tiles can not swell. Said extraction form has also the advantage that the tiles cannot spring outside the mold cavities onto the plungers at the instant of their extraction, especially because of their too quick displacement. Any deterioration of said tiles is therefore avoided.

From the equipment of FIGURE 2 it further results that once the hoisting of the mobile traverse has taken place, by feeding pressure fluid into the hydraulic jacks **24** and **25**, the closing of the electromagnetic valve **45** stops the fluid stream contained therein, so that the mobile traverse is maintained at the upper position reached, without any possibility to lower spontaneously, should the screw **9** accidentally act onto the mobile traverse. Checking of the security valve at the maximum pressure available remains intact, also when the flywheel, for being thrown in unforeseen manner, should shock with force the mobile traverse, which movement would provoke the exhausing of a small quantity of pressure fluid from the jacks, said small fluid quantity being but always sufficient to absorb the energy produced by this unforeseen movement of the screw.

Said suspension of the mobile traverse, besides giving a supplementary security for the correct operation of the press, also provides for the protection of the filling carriage of the press molds.

From the equipment of FIGURE 2 there is further to observe that, when the mobile traverse is displaced to its lower position, this being provoked by the throwing screw **9**, and due to the opening of the electromagnetic valve **45**, and also when said mobile traverse will rest on said matrix, lowering it, the pairs of hydraulic jacks **24–25** and **14–15** will be submitted to an increase of pressure so that the fluid contained therein will surpass the maximum pressure checked by the security valve and will exhaust through the conduits **41** and **43**, returning to the container **33'**, by traversing the non-return valve **48** and the conduit **32**, the non-return valve **49** impeding the return of the fluid to the pumping set **30**, **31**. There is obtained the advantage to convert the kinetic energy of the flywheel **8** of the press to a compression force, said conversion deriving from the braking moment of said flywheel at the time of recording the first step of compression. The non-return valve **48**, once the pistons of the jacks will have wholly entered their cylinders, impedes that the latter be newly submitted to pressure, so that both the mobile traverse and the matrix will remain at the lower position immediately after the first step of compression, and furthermore for all the time of duration of the operation of compression, that is to say till the instant at which the electromagnetic valve **39** will control the feeding of said jacks, as already exhibited hereinabove.

Referring now to FIGURE 3, the hydraulic jacks **24** and **25** are of the double action type. Their cylinders rest on brackets **24'** and **25'** fastened to the press base plate, while their pistons are connected with the mobile traverse through hinges **24''** and **25''**.

Besides said jacks **24** and **25**, two further hydraulic jacks **49** and **50**—of the single action kind—are fed in such a manner as to show the constant tendency to expand. The piston ends of jacks **49** and **50** are provided with regulatable members **51** and **52**, the purpose of which is to ensure their exact positioning at the required level. The piston shaft ends **51** and **52** are set at such a level as to ensure the cooperation with the mobile traverse, or eventually with rigid connecting members of said mobile traverse, as the latter is displaced from the position at which it is resting to that position wherein it contacts the molds to the position which it assumes immediately after the complying of the first step of compression, the whole so that within the travel followed by the mobile traverse the cited jacks **49** and **50** are put into the condition to exert a throw upwards against said mobile traverse.

As it will be seen in the following, the pressure of the fluid to feed the jacks **49** and **50** may be checked once for all in the sense of submitting the throw of said jacks exerted onto the mobile traverse **11** exclusively during this travel. Generally said, the throw exerted by the hydraulic jacks **49** and **50** is smaller than that exerted downwards by the jacks **24**, **25**, so that as a general proceeding a downwards throw will take place, the speed of which will depend mainly from the importance of the contrasting throw exerted by the jacks **49** and **50**. The invention comprises also the case wherein the pressure within the jacks **49** and **50** will reach such a value that the upwards directed throw will be equal to the whole effort produced by the throw of the jacks **24** and **25**, as well as deriving from the weight of the mobile traverse itself.

The hydraulic controlling circuit of the press according to this invention is represented in FIGURE 4, wherein but a variant has been introduced to the arrangement of FIGURE 2.

As a matter of fact, in the examination of said FIGURE 4 in more detail, there is therein to observe that the feeding set for the hydraulic jack **27**, the purpose of which is to provide for the axial displacement of the two friction discs supporting shaft **5**, and the set composed of members **30**, **31** and **33'** for the formation of the fluid pressure, are not changed at all.

The upper rooms of the jacks **24** and **25** are fed through a conduit **53** in free communication with the high pressure conduit **32**, such that said rooms are submitted to fluid pressure without any interruption. The lower rooms of said jacks **24** and **25** are fed with high pressure fluid through the conduit **37**, the electromagnetic valve **59** and the conduit **40**, thus reaching a circuit composed of two parallel branches. The first one, **54**, of these branches ensures a direct feeding of the jacks as the electromagnetic valve **39** opens. The other of said branches, **55**, comprises the electro-magnetic valve **45** which, when closed, impedes the return of pressure fluid to the conduit **40**, while, when opened, it permits said return, comprising further the valve **46** set for the maximum pressure of operation of the press, besides of a throttle valve **56** to be checked at will, and connected in parallel with a further valve **57**. The latter is controlled by mechanical means, more precisely by means of a cam **58** provided on the mobile traverse **11** (FIGURE 3). The position of valve **57** is such that it is closed shortly before the upper plungers of the molds, **12**, contact the matrix, thus forcing the fluid to exhaust through the throttle valve **56**, so that the last portion of the downwards stroke is submitted to braking with the purpose to avoid a too hard engagement of the plungers with said matrix.

Both hydraulic jacks **14** and **15**, which sustain the matrix, are fed through two hydraulic circuits, the first of which is formed by the electromagnetic valve **39** and the conduit **40**, further comprising a throttle valve **59**, a non-return valve **60** and a cock **61**. The second of these hydraulic circuits derives from the compression conduit **32** and comprises a non-return valve **62** and a throttling member **63**, located in a parallel position with respect to the non-return valve **64**. Also in parallel position to the valve **62** is a cock **65**.

When cock **61** is closed and cock **65** open, pressure fluid coming from the conduit **32**, reaches jacks **14** and **15**, such that the latter will remain under pressure also when the

plungers should lower onto the molds, the latter in turn lowering so as to cause the exhausting of a small quantity of fluid past valve **64** and cock **65** back to the conduit **32**. In this manner, and also due to the fact that the matrix is constantly thrown back upwards, said matrix will constantly rest against the upper plungers **12** also during the brief movements of the latter during the compression cycle, a separation taking place only at the end of this operating cycle, as the mobile traverse will have taken again its upper position.

When cock **65** is closed, and cock **61** open, the feeding of the high pressure fluid into the hydraulic jacks **14** and **15** takes place from the conduit **40**, past the throttle valve **59**, non-return valve **60** and cock **61**. When the matrix is forcefully moved downwardly by the mobile traverse, the high pressure fluid cannot return into the conduit **40** because of the blocking caused by the non-return valve **60**, but may pass through the non-return valves **64** and **62** in order to reach the conduit **32**. Although the communication with the valve **39** remains open, the hydraulic jacks **14** and **15** do not receive any pressure fluid, because the valve **39**—due to the lowering of the mobile traverse **11**—in the exhausting position, such that the matrix remains lowered and consequently doesn't follow the movements of the upper plungers, which thus are enabled to detach from them, also only for a short portion of the upwards stroke.

The hydraulic jacks **49** and **50** are fed from a hydraulic circuit derived from the high pressure conduit **32**. A cock **66**, a safety valve **67** with an according gauge **68** for controlling the pressure value, and a pressure accumulating device **69** are foreseen in connection with this feeding conduit. The safety valve **67** is regulatable, so that once it has been set for a certain value there will be no possibility for the hydraulic circuit to surpass the preestablished limit of the pressure. In such a situation, because of opening the cock **66**, a pressure will be established in conduit **70** which will be equal to that which was set by means of the safety valve **67** and controlled by the gauge **68**, after which the cock **66** will be closed again in order to provide in this way a blocked circuit in condition to feed a constant pressure to the hydraulic jacks **49** and **50**. The variations of volume within the interior of the jack rooms, and which will be due to the effort of the mobile traverse during its downwards stroke, will be compensated by the pressure accumulator **69**.

A complete cycle of compression operations obtained by means of the hereabove mentioned equipment comprises the following steps:

(a) *A filling step.*—During this step, valves **38** and **39** are open at the beginning; their task is to maintain jacks **17** and **18** under pressure, such that the lower plungers of the molds are located at the level of the matrix. The lower rooms of jacks **24** and **25** are under pressure. There is thus obtained an upwards thrust against the lower faces of the pistons of said jacks, higher than that applied onto the upper faces of said pistons, inasmuch as the areas of the upper faces are smaller due to the presence of the piston shafts. The mobile traverse is therefore lifted to its upper position, at which it remains blocked following the intervening of the electromagnetic valve **45**, the safety valve **46** and the non-return member connected to the conduit **54**.

Also the matrix is lifted, since the jacks **14** and **15** are under pressure, due to feeding of pressure fluid through the cock **65**, and through the cock **61**. The filling carriage, which is not represented for being universally known, will now move forward, consequently discharging from the press the tiles manufactured in the preceding cycle of operations. At the same instant the electromagnetic valve **38** is moved to its exhaust position, such that jack **17** lowers, and the plungers are moved to the position of filling, thus permitting the filling operation by said carriage. The latter is then moved back and as soon as it is outside the matrix zone, the valve **39** is moved to its exhausting position, thus causing the lowering of the hydraulic jack **18**, and the plungers to rest onto the base plate of the press.

(b) *A preliminary compression step.*—For this operation, valve **39** is in exhaust position, the electromagnetic valve **45** will open, so that the pressure fluid discharges from the lower rooms of the jacks **24** and **25** thus traversing quickly the throttle member **56** and the corresponding valve **57**. Shortly before the plungers contact the matrix **13**, member **58** controls the valve **57** in order to have it in blocking position, so that the pressure fluid will be constrained to travel only through the throttle member **56**, thus considerably reducing the speed of the mobile traverse to avoid a too rapid engagement of the plungers **12** with the matrix. Thus the mobile traverse may smoothly contact said matrix, which is in turn also lowered, thus forcing some pressure fluid to discharge from the hydraulic jacks **14** and **15**. Following the one or the other of the aforesaid cases of operation, the matrix can also be further subjected to a movement by means of the jacks **14** and **15**, or be brought to a stop, respectively. Whatever may be the instant conditions, the mobile traverse will effect the compression of the material in the mold by also exerting a force resulting from the action of the hydraulic jacks **24** and **25** plus its own weight against the counterforce provided by the jacks **14** and **15**.

(c) *A first compression step.*—For this operation, pressure fluid fed into jack **27** causes axial displacement of shaft **5** of the two friction disc **6**, **7** in order to start rotation of the flywheel **8**, which in turn causes downward movement of the mobile traverse **11**. The speed of this downward movement has to be regulated according to the kind and composition of the mass of ceramic material to be compressed, imparting to said flywheel a more or less forced braking action before any further compression occurs, by moving the jack **27** to its exhausting position. This step of compression causes the reduction of the thickness of the mass within the press molds, such that both the mobile traverse **11** and the upper mold plungers **12** move from the position of precompression to a lower level. Immediately after the compression of the material, the flywheel **8** is inverted in its rotation, so as to be recalled upwards, thus drawing again in the same direction its screw **9**. During its displacement downwards the mobile traverse meets the shaft ends **51** and **52** of the hydraulic jacks **49** and **50**, which impart to the mobile traverse an opposed throw. In order to regulate the compression force, it is also necessary to take in account the mechanical resistance possessed by the ceramic mass to be compacted, and also that of the two jacks.

(d) *An air exhausting step.*—As soon as the screw starts on its upwards stroke, the mobile traverse of the press is still subjected to the downward force imparted thereto by the jacks **24** and **25**, on one side, and to the upward force imparted by the jacks **49** and **50**, on the other side, so that the mass is maintained under a certain pressure in order to force the air contained therein out from the molds. As already pointed out, the first step of compression of the material provokes a swelling of it, due to the air contained therein, and further also due to a certain factor of elasticity of the material itself.

In the case of particular material, from which the air cannot be liberated at the first step of compression it is necessary to leave the mass for a sufficient period of time under compression to exhaust the air by passing the intervals existing between the particles of the material and the mold walls.

For these operations the jacks **14** and **15** are fed from the hydraulic circuit which connects them to the conduit **32**, such that the matrix is maintained to rest with force against the upper plungers **12**, while the counterpressure produced by the jacks **49** and **50** will be maintained smaller than the total force exerted by the mobile traverse.

In case of masses of materials susceptible to be at once liberated of the air contained therein, that is to say already under the first step of compression, the jacks **14**

and 15 are fed with fluid under pressure by means of the electromagnetic valve 39; this fluid pressure provided to feed the jacks 49 and 50 is checked in such a manner that the latter provide a throw equal to the total effort produced by the mobile traverse. In this case, the mass of material, besides of swelling during the first step of compression, also exerts a throw onto the plungers 12 thus lifting the same for a very short stroke, sufficient to allow the air contained therein to exhaust. Due to the fact that the pressure onto the mass of material remains unaltered during the whole interval between the first and the second step of compression, there is the certainty that all the air is exhausted from the molds of the press.

(e) *A second compression step.*—In order to realize this second step of compression of the ceramic mass the flywheel 8 of the press is again rotated to move the mobile traverse 11 of the press with a larger force downwardly than for the first step of compression of the mass within the press molds, to insure the final stamping of the ceramic articles to be manufactured, at will. At the end of the compression the flywheel travels immediately upwards, while the electromagnetic valves are controlled so that the lower plungers, the matrix and the mobile traverse of the press will also return upwards, thus complying with all the conditions already considered in referring to the FIGURES 1 and 2. Thus a successive cycle of operations may be repeated at will.

The aforesaid operations are based on the use of molds, the upper plungers are made in the form of covering plates, the sizes of which are larger than those of the mold cavities, so that said covering plates are brought in direct contact with the upper surface of the respective mold or molds, thus requiring a matrix of the kind as already considered hereabove.

The use of larger plungers or covering plates is preferred because the products obtained from them are of a better appearance.

This appearance can be still further improved by the combination of the mold with the improved press according to this invention, since the air is exhausted through the intervals of the lower plungers and the walls of the matrix, while the pressure exerted by the plungers onto said matrix permits to conderably reduce the formation of burrs along the borders of the tiles or like articles. Any burrs which may be formed are of such a thinness, that they can be eliminated without leaving any trace, with the greatest simplicity and quickness.

The improved press according to this invention is also usable with molds having upper plungers entering the mold cavities. Of course, in this case, the matrix will be fixed in a stable position, and the hydraulic jacks 14 and 15 together with their corresponding equipment and circuits for feeding them with pressure fluid are eliminated. The remaining elements and devices are unchanged, and so is also the operation.

A further advantage which can be realized with the press of this invention is represented by the fact—as already stated hereabove—that the discharge of the air from the mass in the mold takes place slower, laterally of the upper plungers of the mold, so that the latter will not be soiled with residues transported by the air on exhausting, also in case the molds have to be heated, as it was necessary to do till now.

This advantage appears to be ascribed to the fact that during the first step of compression, and due to the adiathermic compression, the air which is eventually heated, has all the time necessary to cool in contacting the mass of material to be compressed, such that its slow exhausting will not provoke any condensation of steam onto the faces of the plungers. Of course the means which serve to realize a step of precompression and a step of final compression of the mass, after the preliminary compression, are usable also in the hydraulic presses which have to do with the same drawbacks as those mentioned in the introduction to this specification of the invention.

Referring now to the FIGURE 5 of the drawings, 4 is the fixed upper traverse of the press, said traverse having at its center portion a threaded bushing 10 for causing the up and down movement of the screw 9 of the press.

The roller bearing 20 engages a cylindrical sleeve 71 fixed to an upper portion of the screw spindle 9 and the outer surface of the sleeve 71 is engaged by a packing 72 held by an appropriate ring 73 supported by a bushing 74 which is screwed around the rim 75 of the cup-shaped member 19. In this manner the upper end of the threaded portion 76 of the screw 9 of the press is sealed and the cup-shaped member 19 provides a strong protecting means against any transversal movements and for the improved guiding of said screw 9.

Thus there is formed between member 19 and the screw 9 of the press an annular space 77, which is fluid tightly sealed. This sealed space serves to prevent any leakage of lubricating oil, and it will also prevent introduction of dust and other impurities into said space and between bushing and screw.

As represented by FIGURE 5, when the screw 9 is fully lifted, lower end 78 of its threaded portion is above the lower end of the threaded bushing 10, so that a cylindrical part 79 at the lower end of spindle 9 forms together with the internally threaded bushing 10 a second lower space 80. The cylindrical part 79 projects into the internal surface 81 of another cup-shaped member 21, which is fastened to the traverse 4 by means of bolts 82. The length of the threaded portion of the spindle 9 is about the same as that of the threaded bushing, the thread being called to work only at the instant of the effective compression, in other words as the mechanical load is at its maximum. The space 80 is hermetically closed by means of a packing 83 held by a ring 84 set at the end of the member 21, said packing in turn embracing the cylindrical portion 79 of the screw 9. Said member 21 also bears a bearing of lining 85 in order to engage the screw at its main lower portion, and to protect it against cross loads, further providing a convenient guiding means in the vertical direction.

The space 80 can communicate through the intervals consented by a blocking ring 86 within the member 21 and the lining 85, with a conduit 88. Space 77 communicates with an oil container 89 through a conduit 90, which is conveniently connected to the wall of the member 19.

Said last mentioned conduit enters the interior of said container 89 above the liquid level therein. Said room is in communication through a conduit 88 with another conduit 91 entering said container 89, and the end of which is submerged into the liquid, further bearing an oil filtering member 92 in order to filter the lubricating oil. Two one way valves 93 and 94 opening in opposite directions are provided in conduit 91.

Valve 93 allows the passage of the oil from the container 89 to the space 80 also when the sucking factor is a minimum, this being due to the fact that this valve is deprived of any acting spring thereon.

Valve 94 allows the passage of the oil for lubricating only from the space 80 to the oil container 89. This valve is held in place by a spring 95 so that the oil, which is directed to the oil container can reach the latter only when the oil pressure will reach such a value as to be enabled to open valve 32.

When the press screw 9 is put into rotation from its upper position, as shown in the FIGURE 5, thus effecting its downward stroke, the thread 76 provokes a reduction of volume within the space 80. The oil is consequently compressed and sent all along said thread of the screw 9 and the bushing 10 till it reaches the space 77. If the pressure of the oil surpasses the pre-established maximum value of pressure, valve 94 opens so that a part of the

lubricating oil at least will return to the oil container **89**.

When the screw returns to its upper position, this movement will cause an increase of the volume within the room **80**, there will be cause therein a partial vacuum, by means of which lubricating oil will be sucked from the oil container through conduit **91**, valve **93** and conduit **88**. In the same time, and following the return upwards of the screw, the volume of room **77** decreases, so that the oil therein enclosed is sent back to conduit **90** in order to be discharged into the oil container **89**.

It appears from the above that the invention provides a system for the forced lubrication of sufficient simplicity and immediate function, because of the valve **94**, and without provoking any brakage upon said screw **9**.

From the space **77** air will be sucked from the container and for this reason the latter is provided with an air filter **34** in order to impede the entering of impurities into the lubricating system.

Of course, the invention may be realized in other forms also of a large different mode, without giving out of the boundaries of the same, as those skilled in the art will well understand.

What I claim is:

1. A tile press comprising, in combination, a base having an upper surface; a fixed traverse; support means supporting said fixed traverse in fixed position upwardly spaced from said upper surface of said base; a movable traverse located in the space between said upper surface and said fixed traverse and being guided on said support means for movement toward and away from said upper surface; a threaded bushing carried by said fixed traverse and having an axis substantially normal to said upper surface; a screw spindle extending through said bushing threadingly engaged therewith and having a lower end abutting against said movable traverse; friction drive means cooperating with said screw spindle to turn the latter in one and in the opposite direction about its axis to thereby move said spindle in axial direction so that said lower end of said spindle will exert during downward movement thereof a downward pressure on said movable traverse; hydraulic jack means carried by said base and cooperating with said movable traverse; means for controlling flow of pressure fluid into and out from said hydraulic jack means so as to impart an upward pressure smaller than the downward pressure produced by said spindle; upper mold means carried by said movable traverse; and lower mold means carried by said base.

2. A tile press as defined in claim **1**, wherein said friction drive means comprise a shaft turnably carried by said fixed traverse above the latter substantially normal to the axis of said spindle and movable in direction of its own axis, a pair of friction discs carried spaced from each other by said shaft for rotation therewith, a flywheel located between said friction discs and fixed to the upper end of said spindle, hydraulic means for shifting the shaft in axial direction to alternately bring said friction discs in contact with said flywheel, and control means controlling said hydraulic means in dependence on the position of said flywheel.

3. A tile press as defined in claim **1**, wherein said means for controlling flow of pressure fluid into and out from said hydraulic jack means include a hydraulic pressure accumulator so connected to said hydraulic jack means that the fluid pressure increase created therein during downward pressure of said screw spindle on said movable traverse is stored in said hydraulic pressure accumulator.

4. A tile press as defined in claim **3**, and including safety valve means in circuit with said hydraulic jack means and said hydraulic pressure accumulator.

5. A tile press as defined in claim **1**, and including upper and lower guide means on said fixed traverse for guiding said screw spindle in said axial direction, said lower guide means including stop means cooperating with said movable traverse for stopping upward movement of the latter under the influence of said hydraulic jack means.

6. A tile press as defined in claim **1**, wherein said lower mold means include a matrix and plate means movable relative to said matrix between a lower filling position and an upper ejecting position, and including further hydraulic jack means mounted on said base and yieldably supporting said matrix above said upper surface of said base, additional hydraulic jack means connected to and cooperating with said plate means for moving the latter between said positions thereof, and means for controlling flow of pressure fluid into and out from said further and additional hydraulic jack means.

7. A tile press as defined in claim **1**, wherein said hydraulic jack means comprise a pair of single acting hydraulic jacks engaging said movable traverse at laterally spaced portions thereof for imparting to the latter only an upwardly directed force.

8. A tile press as defined in claim **1**, wherein said hydraulic jack means comprise a pair of double acting hydraulic jacks each having a piston connected to said movable traverse respectively at laterally spaced portions of the latter, and wherein said means for controlling flow of fluid into and out of said hydraulic jack means are arranged to alternatingly feed pressure fluid to one side of each piston and discharge pressure fluid from the other side thereof and vice versa so that said double acting hydraulic jacks may also be used for imparting a downward pressure to said movable traverse independent from said spindle to thus impart a precompression onto material in said mold means.

9. A tile press as defined in claim **8**, and including single acting hydraulic jack means mounted on said base upwardly projecting therefrom, said single acting hydraulic jack means having upper acting ends engaging said movable traverse when the latter is pressed downwardly.

10. A tile press as defined in claim **1**, and including means forming a pair of sealed annular lubricating spaces at opposite ends of said screw bushing about said screw spindle, and means on said screw spindle for respectively increasing and decreasing the volume of at least one of said lubricating spaces during axial movement of said spindle so as to force lubricating oil in said spaces in axial direction along said spindle.

11. A tile press as defined in claim **10**, wherein said means forming said lubricating spaces comprise a pair of cup-shaped members fixed to and respectively projecting upwardly and downwardly from said fixed traverse coaxial with said screw spindle, and sealing means on said cup-shaped members and engaging said spindle.

12. A tile press as defined in claim **11**, and including an oil reservoir, a pair of conduits connecting said oil reservoir with said lubricating spaces, respectively, one of said pair of conduits connecting said one lubricating space with said oil reservoir having an end in said oil reservoir below the level of lubricating oil therein, and the other conduit having an end in said oil reservoir above said level, and a pair of oppositely directed one-way valves connected in parallel to said one conduit.

13. A tile press as defined in claim **11**, and including guide means carried by said cup-shaped members and engaging said spindle for guiding the same in axial direction.

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