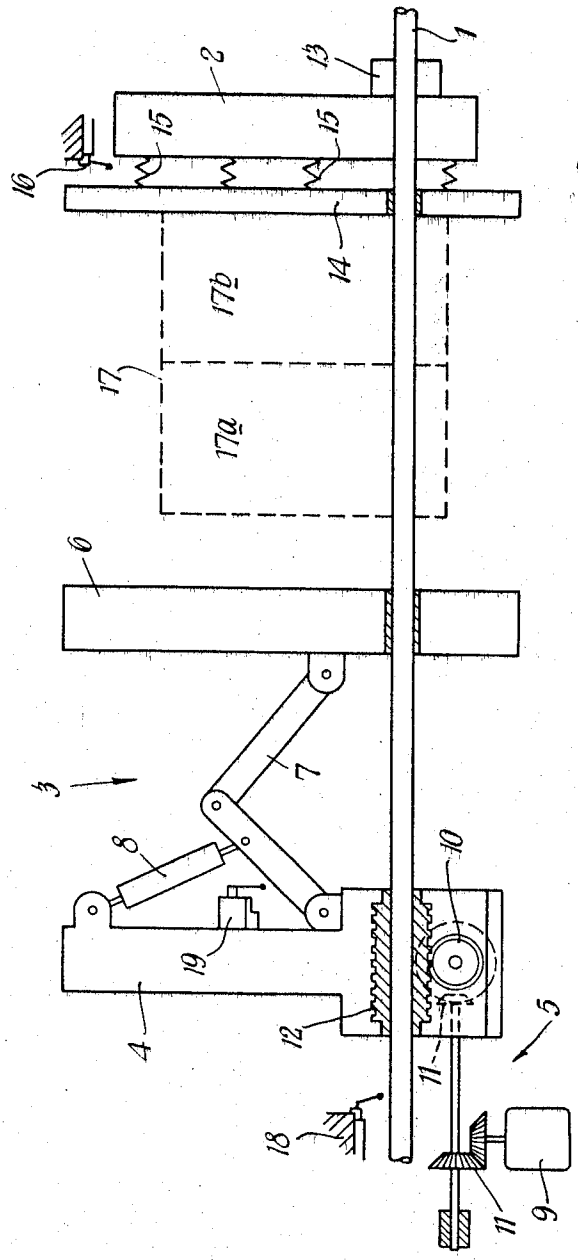
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PRESSES

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PRESSES

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ABSTRACT OF THE DISCLOSURE

In a clamping press having a pair of end platens which are spaced on a frame with a movable platen interposed between them and a mechanical extensible thrust element which interconnects a first end platen and the movable platen so that extension or retraction of the element causes the movable platen to move towards or away from the second end platen and in which the first end platen and movable platen are capable of unified movement relatively towards and away from the second end platen, a method of automatically setting the press by providing sensing means which is responsive to a tool being lightly held between the movable and second end platen so that operation of the sensing means results in either, when the extensible element is in a retracted state, the first end platen being clamped to the frame and the extensible elemen being extended to clamp the tool, or when the extensible element is in an extended state, the element retracting, the first end platen and movable platen moving together towards the second end platen through a predetermined distance, the first end platen being clamped to the frame and the element extending to clamp the tool.

This invention relates to clamping presses and is particularly directed towards a method of automatically adjusting and thereby controlling a locking force applied to a "tool" positioned between relatively movable abutment members of a press of the type specified below.

A press of the type specified comprises a frame carrying two end abutments which are capable of being fixed to a set spacing; an intermediate movable abutment arranged between the end abutments; a thrust element capable of a known amount of extension and capable of being locked in its extended position located between the first end abutment and the intermediate abutment, the thrust element being adapted to exert a clamping force upon a "tool" located between the intermediate abutment and the second end abutment. Hereinafter the combination of the first end abutment, the thrust element and the intermediate movable abument will be termed "the thrust assembly."

The term "tool" as used herein includes any article on which an external locking force or clamping force is to be effected.

A press of the type specified is particularly suitable for applying a locking force to a mould for use with an injection moulding machine or a die for use with a die-casting machine, in both such applications the abutments are known in the art as platens.

When clamping tools of different heights, and in particular when using moulds of different heights (i.e., the full depths of the mould between the clamped faces) in a clamping press, the distances between the second end abutment and the intermediate abutment must be correctly selected for each particular mould height so that when the thrust element retracts the intermediate abutment, the required mould can be inserted in the space between the intermediate abutment and the second end abutment with such clearance that, upon extension of the thrust element, the required compressive clamping or locking force is exerted upon the mould by the tensile reaction of the frame which holds the two end platens in position with the mould and the extended thrust element held between them. Extension of the thrust element to result in the tensile reaction of the frame causes strain in the frame and consequently the fixed end platens move fractionally away from each other a distance which can be predetermined; this distance is termed the "strain distance" and is proportional to the clamping force exerted on the mould.

The frame is preferably in the form of tie bars and the tensile reaction of the tie bars between the two end abutments during clamping of the tool usually results in elongation of the tie bars.

To provide the required positioning of the two end abutments it is necessary to mount them on the frame so that they are capable of relative movement towards and away from each other, and of being locked securely to the frame at any desired spacing within their range of relative movement. This can be done by making one (or both) of the end abutments movable along the frame, providing that both can be positively locked to the frame when required.

By the term "thrust element" is included toggle arrangements, cam arrangements, screw arrangements or the like, the use of which is well known in a press of the type specified.

According to the present invention there is provided a method of adjusting and thereby controlling the operation of a clamping press of the type specified which includes the steps of inserting the tool; automatically carrying out a first movement or sequence of movements which separates the end abutments and which subsequently advances the thrust assembly and second end abutment relative to each other until they are separated by a clamping distance which is equal to the height of the tool plus the predetermined extensible distance of the thrust element less a predetermined strain distance; automatically locking the end abutments relative to each other on the frame; automatically extending the thrust element to clamp the tool between the intermediate abutment and the second end abutment; characterised by automatically actuating sensing means responsive to initial compression of the tool when the tool is lightly held between the second end abutment and the intermediate abutment prior to automatically locking the two end abutments relative to each other on the frame, actuation of said sensing means causing the two end abutments to become automatically located at the clamping distance after which the locking and final extending/clamping step can take place in sequence; and further characterised in that the final extending step of the thrust element to clamp the tool is carried out after the locking of the two end abutments is completed.

Further according to the present invention there is provided a clamping press which includes, a frame carrying two end abutments capable of relative movement towards and away from each other an intermediate movable abutment arranged between the end abutments, an extensible thrust element capable of a known amount of extension and capable of being locked in its extended position located between the first end abutment and the intermediate abutment and adapted to exert a clamping force upon a tool located between the second end abutment and the intermediate abutment; the first end abutment, the thrust element and the intermediate abutment providing in combination a thrust assembly; drive means for moving the thrust assembly and second end abutment relatively towards or away from each other; sensing means responsive to initial compression of the tool actuation of which sensing means results when the tool is lightly held between the second end abutment and the intermediate abutment to

cause the drive means to stop movement of the thrust assembly and second end abutment towards each other; and a control circuit responsive to actuation of the sensing means the arrangement being such that when said sensing means is actuated the control circuit causes, in sequence the first end abutment to become located on the frame at a clamping distance from the second end abutment with the thrust element in its inextended condition, the clamping distance being equal to the height of the tool plus the predetermined extensible distance of the thrust element less a predetermined strain distance, the two end abutments being fixed at the clamping distance, and then the thrust element automatically being extended to clamp the tool between the second end abutment and the intermediate abutment.

Preferably the locking of the two end abutments is indirectly a result of actuation of the sensing means and the sequence of steps of the method according to the present invention comprises inserting the tool between the intermediate abutment and the second end abutment; automatically retracting the thrust assembly from the second end abutment; automatically extending the thrust element; automatically moving the thrust assembly and second end abutment relatively towards each other; automatically actuating the sensing means to stop movement of the thrust assembly and second end abutment towards each other when the tool is lightly held between the intermediate abutment and the second end abutment; automatically retracting the thrust element; further automatically moving the thrust assembly and second end abutment relatively towards each other through the predetermined strain distance until the two end abutments are separated by the clamping distance; fixing the clamping distance between the two end abutments by ensuring that both are positively locked to the frame; automatically extending the thrust element to clamp the tool between the intermediate abutment and the second end abutment; wherein the steps from the step of automatically stopping movement of the thrust assembly and second end abutment towards each other when the tool is lightly held between the intermediate abutment and the second end abutment are so controlled that no step can be carried out until the previous step has been completed.

As will be seen from the above, the initial spacing of the two end abutments may simply be carried out by extending the thrust element and approaching the thrust assembly towards the second end abutment until the mould is lightly held between the second end abutment and the intermediate abutment. Thereafter, it is preferable to retract the thrust element and partially close the resultant gap between the intermediate abutment and the mould. The amount of partial closing movement is conditioned by the predetermined tensile reaction which is to be imposed by the frame when the thrust element is again extended to clamp the mould between the intermediate abutment and the second end abutment by straining the frame.

In an alternative way of putting the method according to the present invention into effect, the locking of the two end abutments takes place directly as a result of actuation of the sensing means and the sequence of steps comprises inserting the tool between the intermediate abutment and the second end abutment; automatically retracting the thrust assembly from the second end abutment; moving the thrust assembly and second end abutment relatively towards each other; automatically actuating the sensing means to stop movement of the thrust assembly and second end abutment towards each other when the tool is lightly held between the intermediate abutment and the second end abutment at which position the two end abutments are separated by the clamping distance; fixing the clamping distance between the two end abutments by ensuring that both are positively locked to the frame; automatically extending the thrust element through a predetermined distance to clamp the tool between the second end abutment and the intermediate abutment.

One embodiment of the present invention will now be described by way of example only, and with reference to the accompanying diagrammatic drawing which illustrates a clamping press constructed according to the present invention and in which the adjustment and control thereof is by the method according to the present invention, the clamping force exerted by the press being imparted to an injection mould.

The press comprises a frame in the form of a pair of parallel tie bars (one of which is illustrated at **1**), and a second end abutment in the form of a fixed platen **2** and a thrust assembly generally indicated at **3**. The platen **2** is fixedly attached at **13** to the tie bars **1** and the thrust assembly **3** is capable of linear movement along and parallel to the tie bars **1** in a direction towards or away from the fixed platen **2**. The thrust assembly **3** comprises a first end abutment shown as an adjustable thrust plate **4**, and an intermediate movable abutment shown as a platen **6** positioned between the thrust plate **4** and the fixed platen **2** and interconnected with the thrust plate **4** through an extensible thrust element shown as a toggle system **7**. A hydraulic ram **8** is operatively associated with the toggle system **7** so that when the ram **8** is reciprocated, extension or retraction of the toggle **7** is effected which causes the platen **6** to move in a linear direction towards or away from the fixed platen **2** independently of movement of the thrust plate **4**.

Drive means (generally indicated at **5**) is associated with the thrust plate **4** for controlling movement of the thrust assembly **3** along the tie bars **1** and includes an electric motor **9** driving a worm wheel **10** through gears **11**, the worm wheel **10** engages with a screwed bush **12** associated with the thrust plate **4**. The bush **12** is mounted on the tie bar **1** so that rotation of the worm wheel **10** by the motor **9** causes movement of the bush **12** and consequently the thrust assembly **3** along the tie bars in a direction towards or away from the fixed platen **2**. Each of the tie bars **1** is equipped with a screwed bush **12** and the arrangement is such that each screwed bush is kept in the correct angular relationship with each other bush.

The fixed platen **2** is provided with sensing means shown in the form of a floating plate **14**. The plate **14** is spring loaded at **15** to be normally urged away from the platen **2**. An electrical switch **16** is provided which is so located that it is tripped by the plate **14** during movement of the plate **14** in a direction towards the platen **2** against the action of the springs **15**. The switch **16** is electrically connected through a control circuit (not shown) to the motor **9** so that its tripping causes de-energisation of the motor and consequently stops movement of the thrust assembly **3** along the tie bars **1**. The switch **16** is also electrically connected through the control circuit to an electric circuit (not shown) which controls the hydraulic ram **8** so that tripping of the switch effects in the ram **8** retracting the toggle system **7** and consequently the moving of the platen **6** in a direction towards the thrust plate **4**.

A mould **17** comprising two portions **17*a*** and **17*b*** is located between the intermediate platen **6** and the fixed platen **2** as shown.

In a setting up operation of the press to accommodate a given mould or other tool, with the toggle system in the retracted position, the motor **9** is energised to cause the thrust assembly **3** to move in a direction away from the fixed platen **2** until a limit switch **18** is actuated. The switch **18** is electrically connected with the control circuit so that actuation of the switch **18** causes the motor **9** to be automatically de-energised and simultaneously causes the electric circuit controlling the hydraulic ram **8** to effect by the ram an extension of the toggle system **7** to a maximum. Consequently, the platen **6** moves in a direction towards the fixed platen **2** independently of the

thrust plate 4. At this position the movable platen 6 is not normally in contact with the mould 17.

When the toggle system is fully extended the motor 9 is automatically energised by switch means (not shown) to cause the thrust assembly 3 to move in a direction towards the fixed platen 2. When the platen 6 abuts the mould 17 the motor 9 is still causing the thrust assembly 3 to move towards the fixed platen 2 and consequently the mould 17 and the floating plate 14 are moved in a direction towards the platen 2 against the springs 15. Eventually the switch 16 is actuated when the mould is lightly held between the platen 6 and the platen 2 and the motor 9 is de-energised. With the press in this state the mould 17 is closed between the platens 6 and 2 but the required clamping force is not applied to it. If the sensing means were eliminated the locking force would be applied to the mould 17 through the drive means 5 but it will be realised that this necessitates the whole force being developed by the electric motor 9. As previously mentioned, the actuation of switch 16 causes the drive means to stop and at the same time causes the ram 8 to retract the toggle system 7 and consequently the platen 6 is moved in a direction away from the platen 2 until a limit switch 19 is tripped which causes the motor to be energised to drive the thrust plate 4 in a direction towards the fixed platen through the predetermined strain distance, when this position is reached the motor 9 is automatically de-energised which fixes the thrust plate 4 relative to the tie bars 1. The distance between the thrust plate 4 and the platen 2 is the "clamping distance." The ram 8 is now automatically actuated to cause the toggle system 7 to be extended to effect a locking force being exerted on the mould 17 between the platens 6 and 2.

It will be seen that with the thrust plate 4 and the platen 2 at the predetermined clamping distance, full extension of the toggle system 7 causes the tie bars 1 to be strained and the tensile force exerted by the tie bars 1 is substantially equal to the force necessary to provide locking between the sections 17*a* and 17*b* of the mould. By suitable measurement and calculation various clamping distances can be derived for the location of the thrust plate 4 relative to the platen 2 depending upon the locking force required for the mould.

Although in the above described embodiment the sensing means includes the floating plate 14 and forms part of the platen 2, several alternative types of sensing means can be used for example, an optical beam device which, when the beam is interrupted, has the same action as tripping the switch 16, the optical beam could for example pass either between the plate 14 and the platen 2 or across the face of the plate 14 in a position where its path is not obstructed by the mould; providing a device in the control circuit which is sensitive to a variation in current in the motor 9, the current variation being caused by strain developed on the motor by a clamping force developed on the mould 17 between the platen 6 and 2 which clamping force is initially developed by the motor and if continued would result in the motor being overloaded and stalling; alternately if the electrical drive means 5 is replaced by a hydraulic motor a device can be incorporated in the control circuit which is responsive to variations in pressure in the hydraulic motor and is adapted to deactuate the hydraulic motor when the hydraulic pressure varies from a predetermined working pressure at the condition in which the tool is lightly held between the end abutment 2 and the intermediate abutment 6.

I claim:

1. A method of setting the operation of a clamping press of the type including a frame carrying two end abutments capable of relative movement towards and away from each other, an intermediate movable abutment arranged between said end abutments, a mechanical extensible thrust element capable of a known amount of extension and capable of being locked in its extended position located between the first end abutment and said intermediate abutment and adapted to exert a clamping force upon a tool located between the second end abutment and said intermediate abutment; said first end abutment, said thrust element and said intermediate abutment providing in combination a thrust assembly; and drive means for moving said thrust assembly and said second end abutment relatively towards or away from each other; which method includes the steps of inserting the tool; automatically carrying out a first movement or sequence of movements which separates said end abutments and which subsequently advances said thrust assembly and said second end abutment relative to each other until they are separated by a clamping distance which is equal to the height of the tool plus the predetermined extensible distance of said thrust element less a predetermined strain distance; automatically locking said end abutments relative to each other on said frame; automatically extending said thrust element to clamp said tool between said intermediate abutment and said second end abutment; characterised by automatically actuating sensing means responsive to initial compression of said tool when said tool is lightly held between said second end abutment and said intermediate abutment prior to automatically locking said two end abutments relative to each other on said frame, actuation of said sensing means causing said two end abutments to become automatically located at said clamping distance after which the locking and final extending/clamping step can take place in sequence; and further characterised in that the final extending step of said thrust element to clamp said tool is carried out after the locking of said two end abutments is completed.

2. The method as claimed in claim 1 wherein the locking of said two end abutments is indirect as a result of actuation of said sensing means and the sequence of steps comprises: inserting said tool between said intermediate abutment and said second end abutment; automatically retracting said thrust assembly from said second end abutment; automatically extending said thrust element; automatically moving said thrust assembly and said second end abutment relatively towards each other; automatically actuating said sensing means to stop movement of said thrust assembly and said second end abutment towards each other when said tool is lightly held between said intermediate abutment and said second end abutment; automatically retracting said thrust element; further automatically moving said thrust assembly and said second end abutment relatively towards each other through the said predetermined strain distance until said two end abutments are separated by the clamping distance; fixing said clamping distance between said two end abutments by ensuring that both are positively locked to said frame; automatically extending said thrust element to clamp the tool between said intermediate abutment and said second end abutment; wherein the steps from the step of automatically stopping movement of said thrust assembly and said second end abutment towards each other when the tool is lightly held between said intermediate abutment and said second end abutment are so controlled that no step can be carried out until the previous step has been completed.

3. The method as claimed in claim 1 wherein the locking of said two end abutments is direct as a result of actuation of said sensing means and the sequence of steps comprises inserting the tool between said intermediate abutment and said second end abutment; automatically retracting said thrust assembly from said second end abutment; moving said thrust assembly and said second end abutment relatively towards each other; automatically actuating said sensing menas to stop movement of said thrust assembly and said second end abutment towards each other when the tool is lightly held between said intermediate abutment and said second end abutment at which position said two end abutments are separated by said clamping distance; fixing said clamping distance between said two end abutments by ensuring that both are

positively locked to the said frame; automatically extending said thrust element through a predetermined distance to clamp the tool between said second end abutment and said intermediate abutment.

4. The method as claimed in claim 3 wherein said thrust element is extended simultaneously with the locking of said two end abutments to said frame.

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