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(54) Method and means for forming blocks from concrete mix at a high production rate and with high shape definition, and the product obtained.

(57) This method and the relative means for forming blocks (10) from concrete mix at a high production rate and with high shape definition comprise a plurality of moulds (3) containing impressions (9A, 9B) each corresponding to one of the two halves into which the block (10) can be divided; these impressions are provided in their two outer flat faces so that a line (13) or bank of moulds can be formed in which two adjacent mating moulds (3) define the cavity to be filled; this line of moulds defines an upper surface (18) which comprises casting sprues and onto which the concrete mix (Z) can be poured for filling purposes. This filling is facilitated by vibrating the mould bank or line (13) for compacting purposes by usual vibrators (26) located on lower longitudinal members (1B, 1B', 1B") provided for their support. The filling is done with the aid of a tray for containing the concrete mix (Z), this tray being formed by removably locating perimetral walls (19) about the sprues (21) of the line (13) of moulds (3); the walls (19) are rested on the upper surface (18) formed by the plurality of mating moulds (3) and containing the casting sprues, and are fitted with rubber gaskets (20) for retaining the liquid component of the concrete mix (Z).

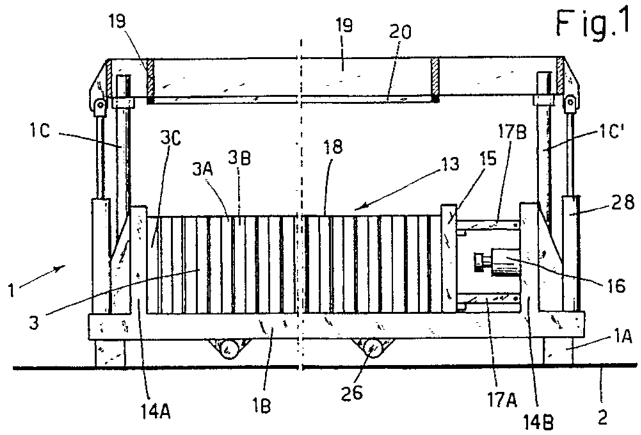

Fig.1

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METHOD AND MEANS FOR FORMING BLOCKS FROM CONCRETE MIX AT A HIGH PRODUCTION RATE AND WITH HIGH SHAPE DEFINITION, AND THE PRODUCT OBTAINED

This invention relates to a method and means for forming blocks from concrete mix, in particular blocks used as inertial masses in household electrical appliances.

As is well known, the considerable hardness, low cost, high specific gravity and the ease with which complex shapes can be formed mean that cement and its agglomerates are increasingly used for purposes other than conventional building, ranging from decorative paving to wall facing, and from statues to products for mechanical use. Of these latter, those used to provide inertia are of particular importance. In this respect, the obvious need to construct structures which are both functional and strong while at the same time using the minimum quantity of costly material often makes it necessary to "weighten" such structures with other low-cost materials which provide an inertial function.

Typical cases of this type are domestic washing machine and dishwasher structures. Washing machines require for containing the rotary drum a tub which has a considerable inertial mass in order to provide stability to the structure in the face of the vibration induced by the rotation of an unbalanced mass (represented by the drum when containing the clothes, especially during spinning). Dishwashers require to be weighted to prevent their movement when opening the door or extracting the dish basket.

In these and other mechanical applications involving cement (generally associated with ferrous and baritic minerals to increase the specific gravity) the blocks generally need to be fixed by bolts or pre-positioned reference elements, requiring dimensional tolerances which are difficult to respect. This is because the usual methods for forming such blocks lead to irregular shapes not only in terms of the level of surface finish but also in dimensional terms.

One of the most usual methods for their formation consists of:

- abundantly filling a base half-mould of metal construction with a granular or friable concrete mix;
- using a blade to remove the excess mix extending beyond reference edges, along which the blade is slid;
- compressing the concrete mix with a counter-mould;
- subjecting the system to a short vibration stage to compact the mix;
- removing the counter-mould;
- transferring the casting onto a conveyor belt which moves slowly through a steam treatment tunnel to accelerate curing. This usual method results in blocks with a very rough surface because of the use of sand and because of the dryness of the concrete mix, these latter being necessary to attain not only low cost but also friability to facilitate removal from the mould. This surface roughness is further worsened by the fact that particles of the cast mix remain attached to the mould and are this removed from the formed block.

This usual method therefore results in blocks without a properly finished surface, leading to very wide dimensional tolerances for the stated reasons, and therefore hardly suitable for combining with machined mechanical or metal parts of a typically high precision.

The said method usually results in a very low production rate with high consequent costs as each individual block has to be constructionally handled by an operator and be treated by a mould vibration machine.

This characteristic of the method usually makes it necessary to shorten the time for vibration-compacting the mix in the mould, so resulting in a concrete block of poor quality.

The poor quality of blocks produced in this manner is also determined by the presence of burrs which continuously increase because of the rapid mould wear along the joining line between the moulds, and induce handling difficulties as they can injure the hands of the operator handling such blocks (for example during their assembly and during the repair of the resultant household electrical appliances).

An object of the present invention is to provide a method and means for forming blocks from concrete mix which result in a higher production rate than conventional methods.

A further object is to provide a method and means which enable blocks to be formed with high dimensional precision.

A further object is to provide concrete blocks, particularly for use as inertial masses for mechanical applications (washing machines, dishwashers etc.), which are very economical.

These and further objects are attained as will be apparent on reading the following detailed description of a method and means for forming blocks from concrete mix at a high production rate and with considerable shape definition, implemented by a plurality of plastics moulds provided with impressions, each of which corresponds to one of the two halves into which the block can be divided, and which are provided in both the outer flat faces of the mould so that a line of moulds can be formed in which two adjacent mating moulds define the cavity to be filled, the line defining an upper surface which contains casting sprues and onto which the concrete mix can be poured for filling purposes. This filling is facilitated by vibrating the mould line for compacting and stratifying purposes by usual vibrators located on lower longitudinal members provided for supporting the mould assembly. The invention is illustrated by way of non-limiting example on the accompanying drawings in which:

Figure 1 is a side view of a block production plant in which the perimetral walls of the containing tray are shown sectioned on a central plane;

Figure 2 is a perspective view of the parts of the plant;

Figure 3 is a section through a mould showing a concrete block under formation by cooperation with an adjacent half-mould;

Figure 4 is a perspective view of a mould resting on two longitudinal members;

Figure 5 is a perspective section through a filling hopper resting on a line of moulds.

With reference to said Figure 1, a fixed frame 1 comprises feet 1A for its support on a floor 2. This fixed frame comprises robust longitudinal members 1B and uprights 1C, 1C'.

The longitudinal members are preferably two in number to form a track 1B', 1B" (Figure 2) on which the moulds 3 can rest securely.

These moulds each consist of two shells 3A and 3B (Figures 2, 4) joined together by bolts 4, possibly acting via stiffening strips 5.

The shells 3A and 3B are joined together at their base by two support brackets 6A and 6B formed from steel angle sections. These brackets comprise projections 6B' and 6B" the purpose of which is to transversely retain the mould shells by being interposed between the two longitudinal member 1B' and 1B".

These shells are constructed of anti-adherent plastics material such as polyethylene, polypropylene, or other known equivalent materials. These shells could however be constructed of plastics material which is not necessarily anti-adherent but is instead surface-coated with anti-adherent material such as polyethyleneterephthalate (PTFE).

An advantageous property of these plastics shells is that they can be injection-moulded. This means that they can be of small thickness, combinable with stiffening ribs, and comprise special shaped portions 8A, 8B to form a comfortable fixing or positioning for mechanical inserts 7 which also provide a strengthening function. With such shaped portions 8A and 8B of the shell, certain regions of the inserts 7 can be made accessible from the outside of the block to enable it to be fixed to a structure by bolts or the like, obviously after the block with its inserts has been removed from its mould.

This is apparent from Figure 3, which shows ideally a concrete block in the form of an irregular ring with its "hole" formed by the two shaped portions 8A and 8B, which have flat ends facing each other to press against the insert interposed between them. When the shell 3A is separated from the shell 3B (shown to the left), that part of the metal insert 7 previously covered by the two shaped portions 8A and 8B is now external to the block and therefore accessible to be used for example to receive the bolts for its fixing to the structure of the appropriate machine.

With the described method the metal inserts are very simple to position and/or retain, not only by centering or mounting on usual pegs in the half-mould 3B, but also by magnets 27 inserted into the rear of the impression to retain the iron insert before it is finally fixed by the action of the adjacent mould 3A.

The two shells 3A and 3B joined by the bolts 4 or by other means, including welding, thus form a mould (Figure 4) comprising two semi-impressions 9A and 9B which define the shape of a given concrete block on mating with another mould.

This is clear from Figure 3, which shows a mould 3A-3B' in contact with a half-mould 3B to define a ring-shaped concrete block 10. This mould is formed from two different shells 3A, 3B' joined together by bolts 4.

The front and rear surfaces of the mould 3 can be made to mate with the rear and front surfaces respectively of other moulds 3 by special fitting elements or by simple engagement between the pegs 11 and holes 12.

This mating operation is effected in such a manner as not only to properly seal the parts together and prevent the formation of burrs along their joining line, but also to provide centering or coaxiality between the moulds so that the shape defined by them is correct, and in addition to mechanically rigidify and thus retain the set of aligned moulds in the transverse direction.

With reference to Figure 1, the moulds 3 are rested (possibly via their brackets 6A and 6B of Figure 4) on the longitudinal members 1B' and 1B", and are moved up alongside each other into mutual contact to form a very long row of moulds. This row or line of moulds 13 can be flanked by other parallel lines 13 of moulds 3 to include overall even thousands of moulds (only one row is shown on the drawings).

Conceptually there is no limit to their number. However from the practical aspect this number is governed by the need to butt-join the various longitudinal members 1B and other longitudinal parts of the structure 1 together, and by the time required to remove the concrete blocks from their moulds, which must obviously be compatible with the production needs determined by other operational requirements (such as the work shifts).

Each row of moulds is rested via an end half-mould 3 against a first fixed shoulder 14A.

In this manner one presser plate 15 can compress the whole row 13 to maintain all its constituent moulds in strong closure contact. The presser plate 15 is initially operated by a hydraulic thrust piston, after which, when the position of maximum contact between the moulds 3 has been attained, struts 17A, 17B are interposed between a second fixed shoulder 14B and the presser plate 15, to maintain the maximum contact position previously attained by the hydraulic piston 16.

The hydraulic piston 16, which reacts against or is fixed to the fixed structure 1, for example via the second fixed shoulder 14B, can then be disengaged. In Figure 1 it is shown in its disengaged position.

At this point of the production cycle a rectangular perimetral frame provided lowerly with rubber gaskets 20 is rested on the surface 18 formed by the upper faces of the moulds 3.

This perimetral frame forms a tray about a series of holes or slots 21 present in the upper faces of the moulds 3 and communicating with the space for the block to be moulded.

Generally the intersection between the holes and the surface 18 is represented by a flat surface on the block when it is removed from the mould.

In this respect, these holes conceptually represent the mould feed sprue, but this sprue is generally so short as to be represented by a mere flat surface on the casting. The concrete mix Z is poured into the parallelepiped tray 18, 19 and flows via the various holes 21 into the various mould cavities, so filling them. This filling is facilitated by a raking action using manually or mechanically operated blades to shift the concrete mix so that the holes receive that concrete mix lying on the remaining upper flat surface of the moulds.

As an alternative to this method of filling the mould spaces using a parallelepiped tray, a hopper-shaped tray 22 is used resting via gaskets 23 on the plurality of moulds 3D, at the ends of slots 21A (Figure 5).

The hopper 22 is able to slide along the row of moulds, so that it also performs the said raking function, especially if the hopper is provided with transverse sheet metal baffles 24 used to strengthen the hopper.

Penetration of the concrete mix Z into the moulds is facilitated by vibrating the moulds, so that, depending on the actual manual or automatic filling method used, the filling stage also comprises continuous or intermittent vibration.

Longitudinally sliding the hopper 22 in the direction of the arrows F also has a further advantage, namely of being able to move along the row of moulds until the concrete mix contained in the hopper is completely used.

In this respect, in this type of production process it is difficult to prepare an exact quantity of concrete mix, it being preferable to use a number of moulds greater then the number effectively fillable, and then fill them "one at a time" until the concrete mix is finished.

The expression "one at a time" is used merely to indicate a progressive filling of the line of moulds. In fact, whether the parallelepiped tray or the hopper tray is used, the moulds are filled simultaneously in very large groups, which could also represent nearly the whole of them. This is what happens for example in the case of the parallelepiped tray, in which the poured concrete mix Z immediately penetrates through all the slots 21 which it meets. To prevent the moulds being only party filled, thick slabs of expanded polystyrene 25 (or other equivalent material) are placed within the perimeter 19 to cover the various slots 21 and act as stopper. When the moulds (those to the right in Figure 2) with their slots 21 open have been filled and it is ascertained that more concrete mix Z is available, it is used by progressively uncovering further slots 21 (in the direction of the line of adjacent moulds) by removing the slabs 25B, 25A ... which cover them. After this the perimeter 19 is raised by usual means which by way of the example are shown on the drawing as hydraulic pistons 28 cooperating with guide uprights 1C, 1C' and usual safety means which protect against falling. In the case of the slidable hopper (Figure 5) this slab method serves no purpose, as the same result is obtained by sliding the hopper in the direction F along the line of moulds, while the concrete mix is still present within it. When the moulds 3 have been filled, with or without vibration and with or without the "head material" over the slots, the concrete mix contained in the moulds is then compacted. This is done by vibrating the line of moulds 13 for a time indicatively between 3 and 10 minutes by vertically vibrating the longitudinal members 1B (1B', 1B") on which the mould assembly rests. This oscillation is implemented by usual vibrators 26 operating with known and currently used methods for regulating amplitude and frequency to the required acceleration values. The purpose of this vibration stage is not only to compact, but also to define the surface state of the casting under formation. In this respect, the concrete mix, indicatively composed of 40% of water, 16% of cement and the remainder of solids of a certain size, such as the small stones typically found in sand, iron scale or other minerals of high specific gravity (barite) generally used in this type of inertial block production.

During the vibration of each mould 3, those particles of greater mass P (stones) in contact with it acquire a higher kinetic energy which causes them to withdraw from the forming surface of the mould and to travel towards its interior. Material with the smallest particle size and specific gravity therefore remains on the outside of the block in contact with its formation surface. In this specific case, this material consists of a combination of water and cement, forming so-called cement grout. When vibration is complete, the concrete block defined in this manner is left to harden. When removed from its mould, the block will be extremely smooth and of a precise shape, and in addition will have a higher chemical resistance and mechanical strength deriving from a peripheral or surface concentration of soft material (cement) of very low porosity. To remove the blocks 10 from their moulds it is necessary only to release the struts 17A, 17B from their usual fixing means (bolts, pegs), or to remove the presser plate 15 associated with them. In this manner the various moulds 3 are axially released from each other, ready for the manual removal of the block formed within them. This removal is favoured by the extremely smooth surface of the mould impressions and by the anti-adhesive character of the plastics material used for the mould construction, and is further facilitated by usual concrete detaching agents, of which the most economical include diesel oil and vegetable oil mixtures, paraffins and waxy substances, and which are sprayed onto the open mould before pouring the concrete mix into it. This production method can obviously use concrete mixes with added concrete fluidifiers in the known manner. An example of these is the product known commercially as FLUIMENT 40.

Claims

1. A method characterised by:
   - combining into a bank a succession of moulds at least part of which comprise in their two outer flat faces impressions which each correspond to one of the two halves into which the concrete block to be produced can be divided, said bank defining an upper external surface into which pouring sprues formed by the moulds open;
   - pouring a concrete mix into the moulds;
   - vibrating the bank at least during the pouring of the concrete mix.

2. A method as claimed in the preceding claim, characterised by vibrating the moulds, at a frequency and amplitude usual in the concrete field, for a time indicatively of between three and ten minutes, said vibration being obtained by usual means (26) acting on the longitudinal members (1B, 1B', 1B") on which the moulds rest.

3. A method as claimed in the preceding claims, characterised by open moulds (3) each formed from two shells (3A, 3B) of plastics material with anti-adherent properties, such as polyethylene (PE), polyethyleneterephthalate (PTFE), or acrylonitrile-butadiene-styrene (ABS).

4. A method as claimed in the preceding claims, characterised in that the moulds (3) are filled by forming on that upper surface (18) comprising the pouring slots (21) a tray for holding the concrete mix (Z) with which the moulds are to be filled.

5. Means for implementing the method, characterised by comprising:
   a) moulds provided in their two outer flat faces with impressions each corresponding to one of the two halves into which the concrete block to be produced can be divided, and further provided with pouring sprues, said moulds having at least one further flat face which is perpendicular to the faces provided with impressions, and into which at least one pouring sprue opens;
   b) means for combining a plurality of said moulds to form a bank, and means for supporting said bank;
   c) vibrator means associated with said support means to transmit vibrations to said bank;
   d) means for pouring the concrete mix; and
   e) means to be rested on the bank to define the pouring region.

6. Means as claimed in claim 5, characterised by plastics moulds provided with magnetic elements (27) inserted into their rear for retaining iron inserts (7) within the concrete block (10).

7. Means as claimed in claim 6, characterised by a holding tray for the concrete mix (Z) formed from a frame (19) which is provided with preferably rubber gaskets (20) to retain the liquid part of the concrete mix (Z) in its interior, and which is laid perimetrally about the pouring slots (21).

8. Means as claimed in claim 7, characterised by a raisable perimetral frame (19) which can be

raised vertically and fixed in its raised position by usual means.

9. Means as claimed in the preceding claims, characterised by a holding tray for the concrete mix (Z) which is hopper shaped with a rectangular discharge mouth the side dimension of which is equal to the width of the slot (Figure 5).

10. Means as claimed in the preceding claim, characterised by a holding tray for the concrete mix (Z) which is slidable in a fluid-tight manner along the upper surface (18) formed by the line (13) of moulds (3), to sequentially fill the moulds until the concrete mix contained in it has been totally used.

11. Means as claimed in claim 6, characterised by a holding tray which additionally comprises removable expanded polystyrene slabs (25A, 25B) for covering and possibly uncovering the slots (21) of those moulds (3) for which the possibility of only partial filling is to be avoided.

12. Means as claimed in the preceding claims, characterised by a concrete mix with added concrete fluidifying agent in accordance with usual good practice.

13. A product or block formed from concrete mix by the production method claimed in the preceding claims.

Fig.1

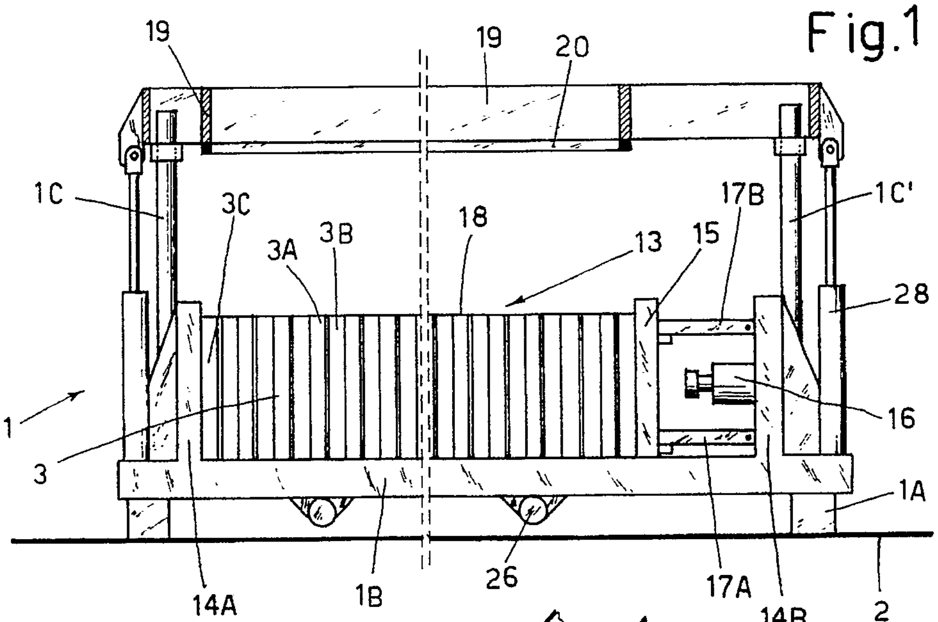
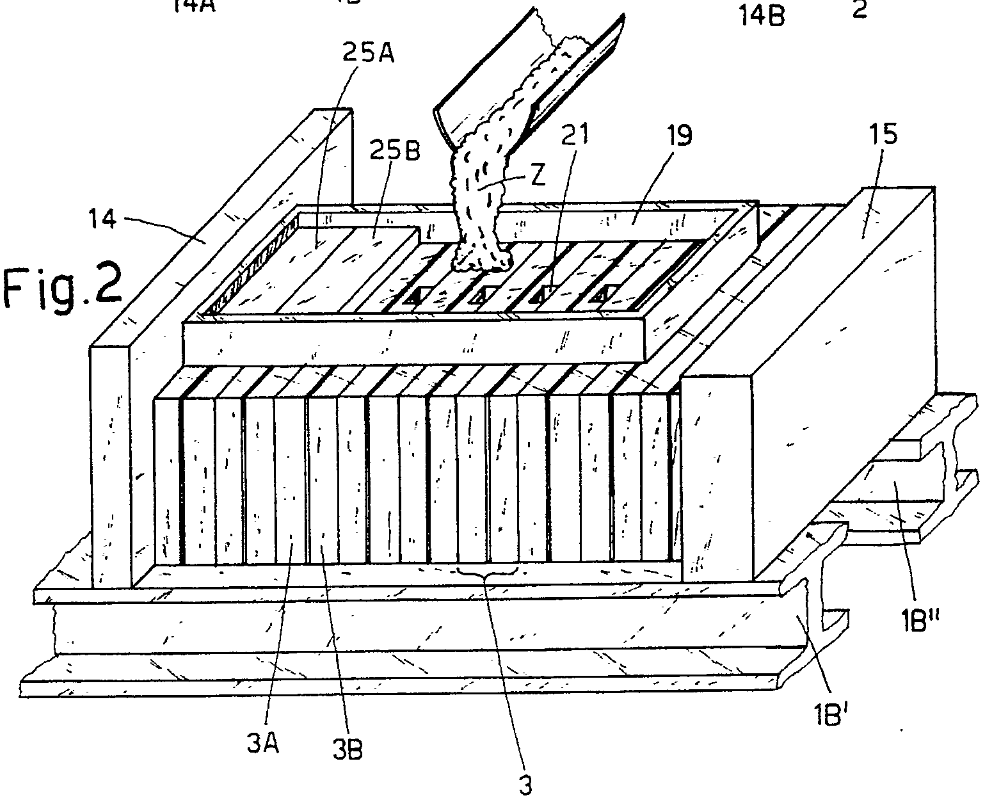

19
19
20
1C
3C
3A
3B
18
13
15
17B
1C'
28
1
3
16
1A
14A
1B
26
17A
14B
2

Fig.2


25A
25B
21
19
15
Z
14
1B''
1B'
3A
3B
3

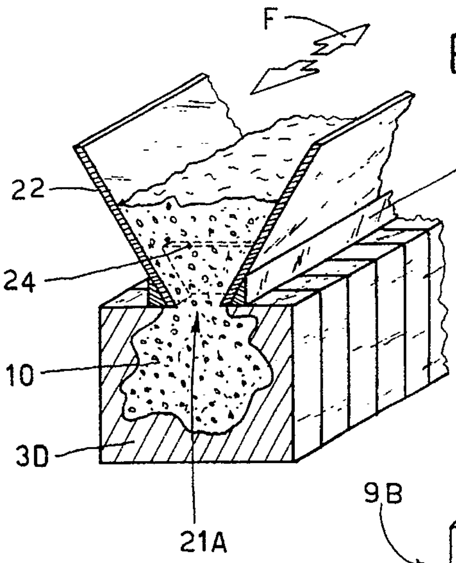


Fig.5

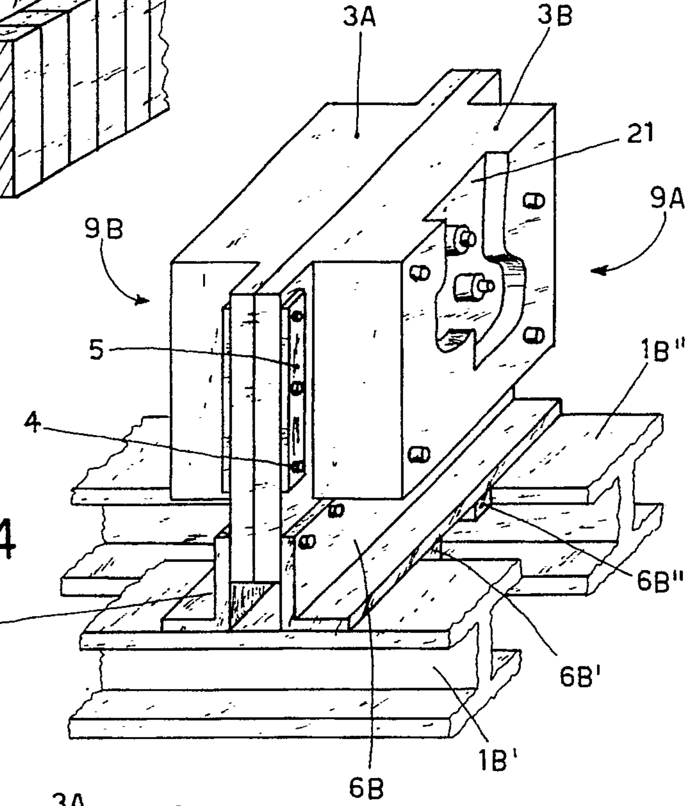


Fig.4

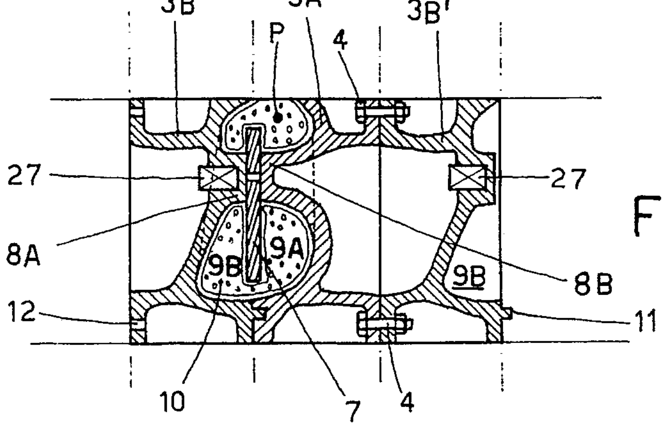


Fig.3