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**(54) Production of cast steel parts provided with inner cavities**

Herstellung von Gussstahlgegenständen mit inneren Hohlräumen

Fabrication de pièces avec cavités internes en acier moulé

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## Description

[0001] The present invention relates to improvements introduced in the production of cast steel parts provided with inner cavities, particularly concerning a mould assembly therefor, which permit substantial advantages to be obtained relative to the present state of the art.

[0002] The steel parts to be produced according to the present invention are preferably wear-resistant cast steel parts, in particular the teeth of excavators and other earth-moving machines, in which the part has a generally pointed structure with an inner cavity, which is open at one end of the part, thus permitting it to be connected to an acceptance or male part of the machine, and therefore enabling it to be replaced when it is worn.

[0003] US Patent 2.101.046 to Blettner discloses some improvements in the casting of a plurality of pistons for combustion engines, however, no reference is made to the problems of internal recesses in steel castings, or to measures for controlling the location of said recesses.

[0004] Owing to the complex structure of the part, conventional casting methods require the use of sinkheads with sufficient additional volume to permit localisation of the recess which is formed at the end of the period of solidification of the part, thus enabling sound parts to be obtained. In the methods currently known, the dimensions of the assembly of each casting box, with its core or compartment, and the corresponding sinkheads, thus need to be considerable in order for these parts to be produced.

[0005] Owing to the need to reduce the price of the parts, at the same time as obtaining a high quality thereof, it has become necessary in the industry to improve the production method of these parts, by obtaining optimum use of the steel employed in the casting, thus providing a high coefficient of use of the said cast steel mass, and simultaneously permitting a larger number of parts to be cast for a specific volume of boxes stacked, in order to obtain increased productivity.

[0006] These have been the objectives of the applicants in developing their invention, which can be summarised as:

- improvement of the system of filling and supply of the parts, thus obtaining improved output measured in terms of the ratio between cast steel and net steel;
- reduction of the need for molten steel, since, as the quantity of fluid steel for a specific production is reduced, the capacity of the casting means can be smaller, and optionally some of the furnaces currently used in the casting installations can be eliminated;
- increase of the quantity of parts per mould;
- improvement of the final quality of the parts;
- reduction of the production costs.

[0007] In order to achieve these objectives, the improvements which constitute the basis of the present invention are based substantially on the production of parts by means of a filling system using moulds comprising successive stacking of compartments or casting boxes, each of which has a set of parts supplied from a collector or central casting block, which facilitates successive filling of each of the levels of the mould formed by the various compartments, in association with specific means of designing the inner cavity of the part, in order to obtain controlled localisation of its recess, thus making it compatible with correct resistance of the part.

[0008] Substantially these improvements are characterised in that at the end of the core which corresponds to the inner cavity of each of the parts, there is provided a projection for controlling a recess which is disposed inside the part, in the area distant from the outer surface thereof, the entire filling taking place from the single central filling duct, without supply sinkheads.

[0009] It is thus possible to obtain the above-described objectives, by eliminating the sinkhead systems conventionally required, and permitting casting of a large number of parts simultaneously, without requiring sinkheads.

[0010] At the same time, a considerable increase of weight of the metal is obtained by opening the casting ladle, enabling furnace sizes larger than those currently used habitually to be worked, and thus obtaining steel at a lower processing cost.

[0011] Additionally, improved quality of the part is obtained by using moulds which are more highly resistant, thus enabling defects caused by inclusions of sand to be avoided, and providing improvements in the surface appearance of the product, as well as providing improved dimensional accuracy thereof.

[0012] Similarly, the formation of cold areas in the parts is avoided, owing mainly to the reduced path of the steel, and to the increased metallostatic pressure and the low level of cooling produced by the new type of mould.

[0013] An additional advantage consists of reducing the burr on the parts, thus reducing the finishing time necessary.

[0014] Another feature of the present improvements consists of the reduced consumption of sand for a specific quantity of steel cast, thus constituting an additional cost-reduction factor.

[0015] For the purpose of improved understanding, explanatory drawings of a preferred embodiment of the improvements which form the basis of the present invention are attached by way of example.

Figure 1 is a schematic plan view showing the arrangement of a mould assembly for the production of steel parts in accordance with the present invention.

Figure 2 is a longitudinal cross-section through the cutting plane indicated in Figure 1;

Figure 3 shows schematically a plan view of the assembly produced by casting in accordance with the present invention, corresponding to one of the compartments;

Figure 4 is an elevated view of the assembly of casting components along a cross-section through the cutting area indicated in Figure 3;

Figure 5 is a longitudinal cross-section of a part produced in accordance with the present invention; Figure 6 is a plan view of the part shown in Figure 5; Figure 7 is a cross-section through the plane indicated in Figure 6;

Figure 8 shows in detail the end of a male part or core corresponding to the inner cavity of the cast part;

Figure 9 is a transverse cross-section through the plane indicated in Figure 8;

Figure 10 and 11 are views corresponding to Figures 8 and 9, in a truncated pyramid end projection version;

Figures 12 and 13 are a lateral view and a cross-section through a cutting plane indicated of an end projection similar to Figures 8 and 9, with a lobar end;

Figure 14 shows a detachable-type end projection; Figure 15 is an enlarged cross-section corresponding to the casting of a part according to the present invention.

**[0016]** As will be appreciated from the Figures, the present invention is based on the preparation of multiple boxes such as 1, 2, 3, 4, 5 and 6, with their corresponding cores, forming a mould assembly in which there are distributed multiple levels of individual parts as indicated by number 7 in Figure 1, of a variable number and arrangement, which in the example shown is radial, but which could be of another type, originating in a common axial filling duct 8, without any sinkheads whatsoever.

**[0017]** After removal from the mould has taken place, the component shown in Figures 3 and 4 is obtained, in which multiple levels, i.e. 9, 10, 11, 12 and 13 can be seen, each of which consists of a number of individual parts which in this case are disposed radially without a sinkhead, as can be seen from Figures 1 and 3, starting from the same central block 14, which has previously been used for filling.

**[0018]** According to the present invention, each of the individual components produced, such as a tooth for an earth-moving machine, designated 15 in Figure 5, consists of a cast steel part provided with an inner cavity 16, which is open at the end connection surface 17 of the tooth, and which, according to the present invention, has a projection 18, which is constituted in a specific manner at the time of casting, in order to obtain localisation of the recess in an inner area of the tooth, preferably in an area which corresponds to the neutral line of the part, and in conditions of separation relative to the outer surface of the part, in order to avoid fragile areas.

The present invention also includes the optional arrangement of thickened parts such as 19, which are designed to provide a larger cross-section of the material in the area in which the inner recess will be provided.

**[0019]** In order to obtain accurate localisation of the inner recess in the cavity 18, according to the present invention, in the end of the male part designed for producing the cavity 17, as shown in the examples in Figures 8 to 13, there is a projection 20 in the end of the male part 21, Figures 8 and 9, such that the said projection 20 can ensure communication of the recess produced with the atmosphere, by means of its own core, by producing gas and heat, such that control of the recess formed is obtained, and that by providing the connection with the atmosphere, problems of deformation of the part are avoided, since normally, in the area in which the inner recess is formed, a depression caused by the pressure difference may occur.

**[0020]** The cross-section of the projection 20 will be variable according to the needs of each case, for example it can be circular, as shown in Figures 8 and 9, or it can be a truncated pyramid, as in the projection 22 in Figures 10 and 11, or it can be lobar, as in the projection 23 in Figures 12 and 13, which has a head 24 consisting of a series of projecting lobes, which may be pointed.

**[0021]** According to the present invention, the projection can also be of the detachable type, as shown in Figure 14, in which the male part 25 has an aperture in which there is mounted the projection 26, which, in the case shown, is a lobar head 27.

**[0022]** By means of this arrangement of components as shown in Figure 15, during casting the area of the projection, indicated 28, is disposed in a preferably neutral area of the part 29, such that the recess which is formed in this area 28 does not have any functional consequences on the finished part. The communication with the atmosphere via the sand 30 of the core enables the pressures to be equalised in the recess area, thus avoiding local depressions, such as those which would occur in an inner recess without the control provided according to the present invention.

**[0023]** The nature of the projection 28 is such that it facilitates communication with the atmosphere, as previously described, without also facilitating the addition of heat and gases, by which means the recess formed is controlled.

**[0024]** As will be appreciated, the present invention has been explained relative to embodiments of which the details can be varied according to the capabilities of persons skilled in the art, without departing from the context of the claims.

## Claims

1. Mould assembly for the production of cast steel parts, provided with inner cavities, in which the moulds are radially arranged in a stack about a

common filling conduit, each mould comprising a cavity with a core for the production of parts with a hollow end, the core communicating with the atmosphere at the outer end, characterized in that at the end of the core corresponding to the inner cavity of each of the parts to be moulded a projection is arranged of a material which can generate heat and gases at the moment of casting for controlling the recess after casting to be located in an area distant from the outer surfaces of the casting. 5 10

2. Mould assembly according to claim 1 characterized in that the projection of the core is of the detachable type. 15

### Patentansprüche

1. Formanordnung für die Herstellung von Gußstahleilen, welche mit inneren Hohlräumen versehen sind, wobei bei der Formanordnung die Formen in einem Stapel um eine gemeinsame Einfüllleitung herum radial angeordnet sind, wobei jede Form einen Hohlraum mit einem Kern für die Herstellung von Teilen mit einem hohlen Ende aufweist und wobei der Kern mit der Atmosphäre an dem anderen Ende kommuniziert, **dadurch gekennzeichnet**, daß an dem Ende des Kerns, welcher dem inneren Hohlraum eines jeden der zu formenden Teile entspricht, ein Vorsprung aus einem Material angeordnet ist, welches zu dem Zeitpunkt des Gießens Wärme und Gase erzeugen kann, um die Ausnehmung nach dem Gießen so zu steuern, daß sie in einem Bereich im Abstand von den Außenseiten des Gußstücks angeordnet ist. 20 25 30 35
2. Formanordnung nach Anspruch 1, **dadurch gekennzeichnet**, daß der Vorsprung des Kerns von der abnehmbaren Art ist. 35

### Revendications

1. Ensemble de moules pour la production de pièces en acier fondu munies de cavités internes, les moules dans l'ensemble de moules étant disposés radialement en empilage autour d'une conduite de remplissage commune, chaque moule comprenant une cavité avec un noyau pour la production de pièces présentant une extrémité creuse et le noyau communiquant avec l'atmosphère sur l'extrémité extérieure, caractérisé en ce que sur l'extrémité du noyau correspondant à la cavité interne de chacune des pièces à mouler est disposée une saillie en matériau pouvant générer de la chaleur et des gaz au moment de la coulée pur contrôler l'évidement après la coulée située en une zone distante des surfaces extérieures de la pièce moulée. 40 45 50 55

2. Ensemble de moules selon la revendication 1,

caractérisé en ce que la saillie du noyau est du type détachable.

FIG.1

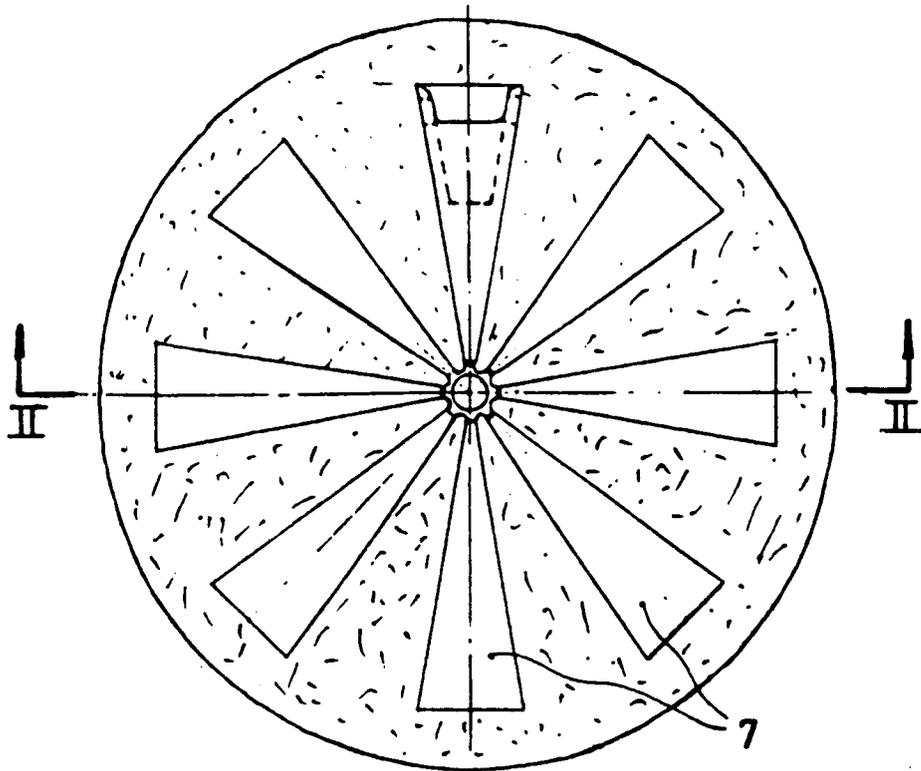


FIG.2

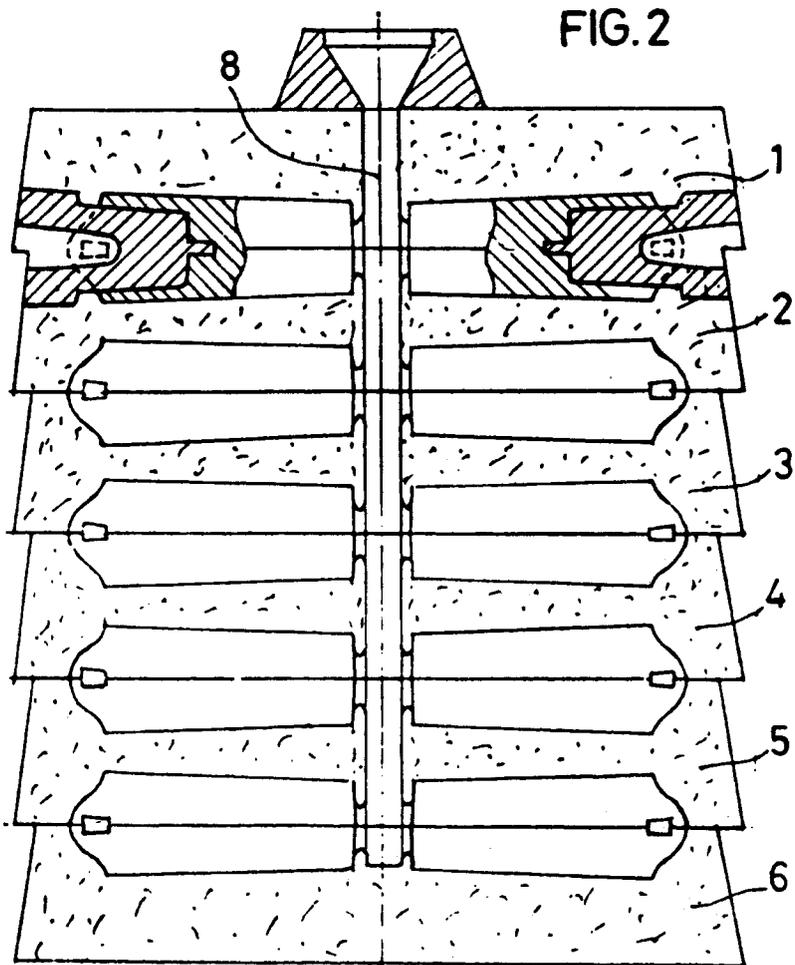


FIG. 3

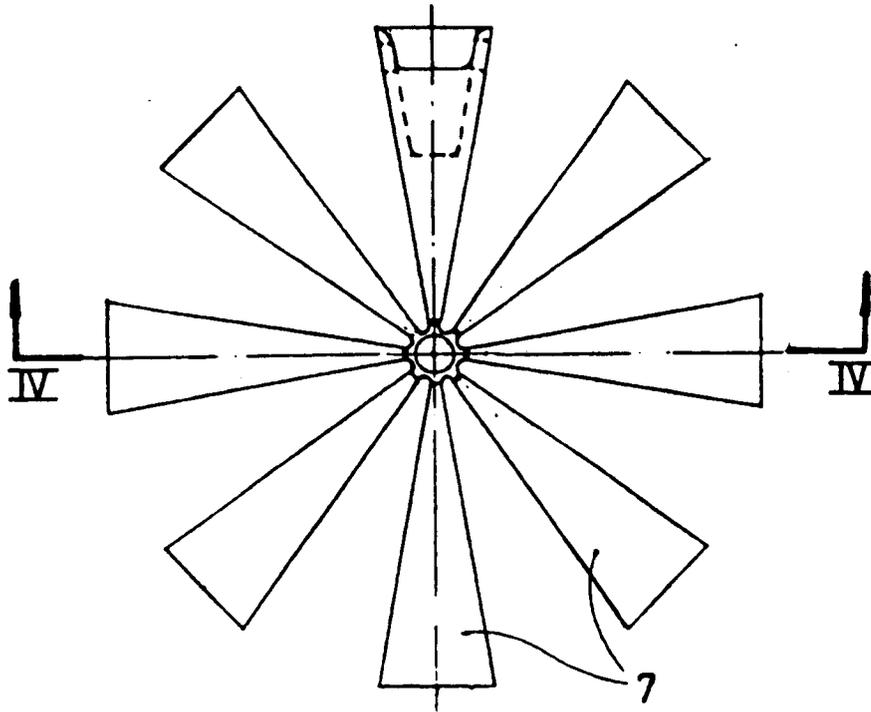


FIG. 4

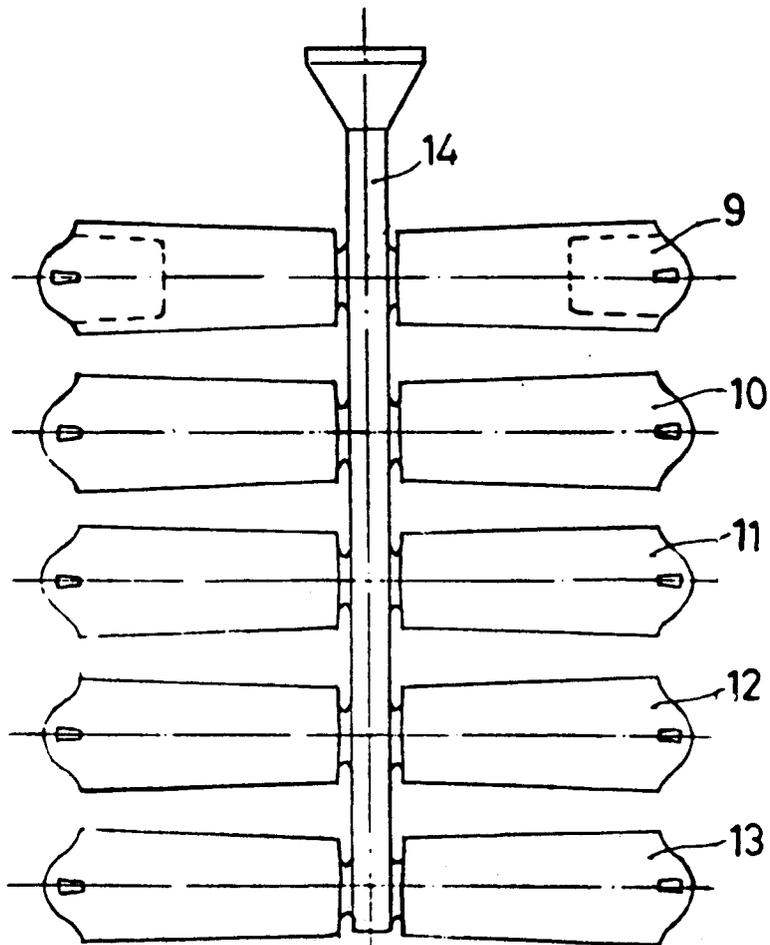


FIG.5

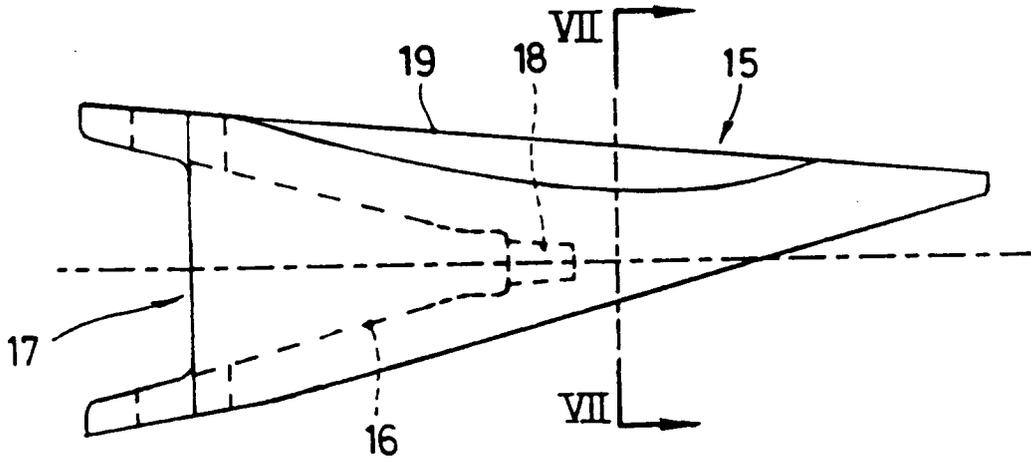


FIG.6

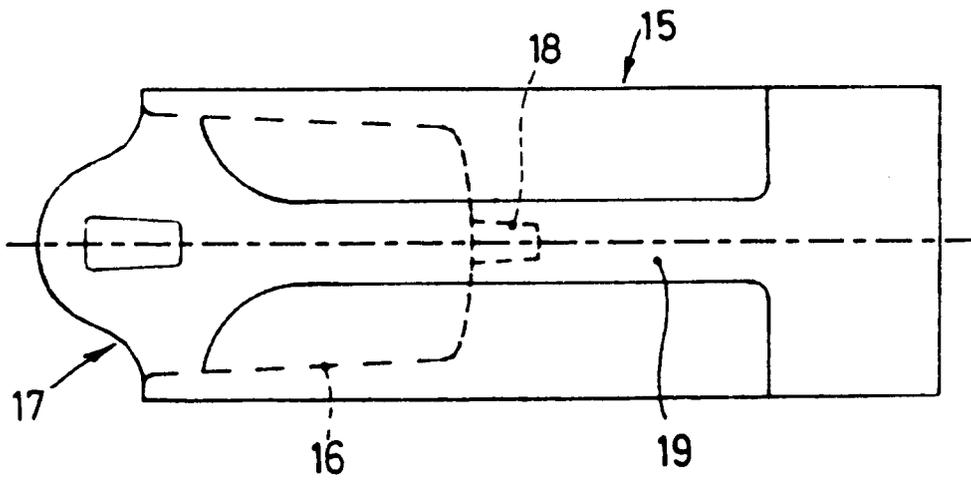
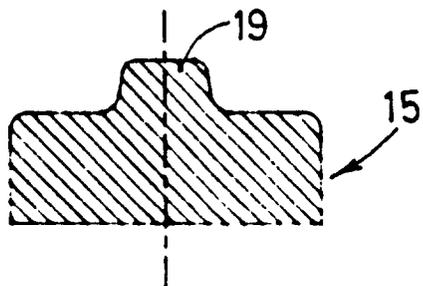


FIG.7



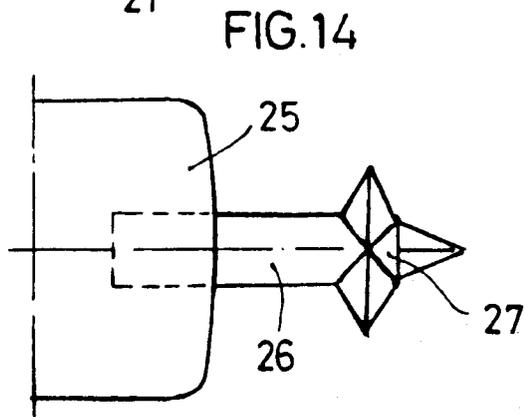
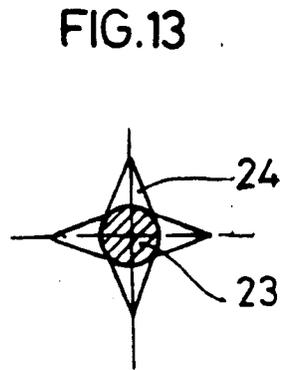
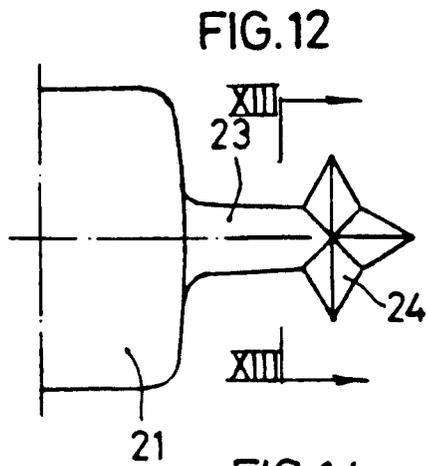
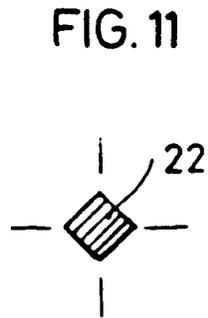
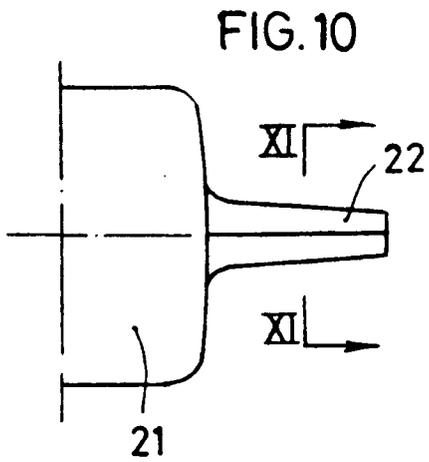
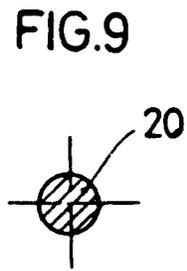
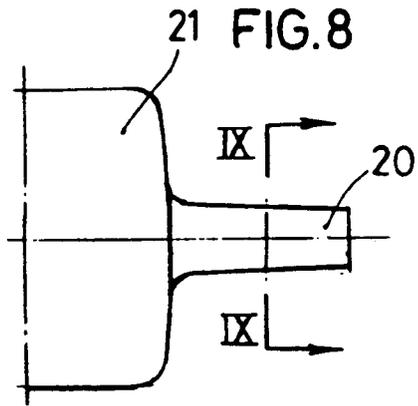


FIG. 15

