

 **EUROPEAN PATENT APPLICATION**

 Application number: 82830116.8

 Int. Cl.³: B 02 C 18/18

 Date of filing: 29.04.82

 Date of publication of application:
 09.11.83 Bulletin 83/45

 Designated Contracting States:
 AT BE CH DE FR GB LI NL SE

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 **Improved sector knife and driving shaft arrangement, particularly for crushing apparatus and the like.**

 The sector knife and driving shaft arrangement comprises a knife consisting of a plurality of cutting sectors (1, 1', 1''), a plurality of spacing sectors (2) and a locking sector (3), the cutting (1) and spacing sectors (2) being provided with restraining elements, consisting of male and female dovetail shaped members respectively, while the driving shaft is provided with circumferential slots (8) including mating restraining elements extending all along the circumference with the exception of the circle arc (10) subtended by the locking sector (B). This circle arc, devoid of any restraining elements, is effective to provide a zone for introducing the cutting (1, 1', 1'') and spacing sectors (2) into the related slot therein; the locking sector (3) will be introduced for geometrically locking all of the sectors and fixed to the driving shaft by known fixing means, (4, 5).

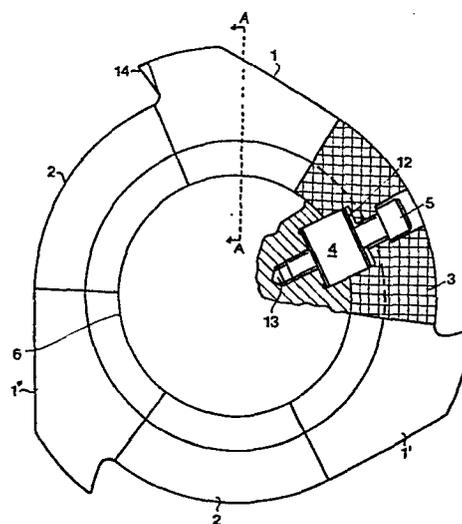


FIG 1

BACKGROUND OF THE INVENTION

The present invention generally relates to crushing machines and, more specifically, to an improved arrangement of the sector knives and driving shafts therefor.

The crushing machines or "crushers" are well known in the art, and they operate to crush large size materials to small pieces effective to be used in industrial processes.

Among the known crushers, the so-called rotating knife crusher specifically pertains to the field of the present invention.

These rotating knife crushers generally comprise two shafts, extending parallelly to one another and oppositely rotating, thereon there is mounted a plurality of spacer ring members, which are spaced from one another by a distance substantially corresponding to the thickness thereof.

More specifically, with the shafts adjoining one another, the ring members of one of said shafts rotate in the gaps provided between the adjacent ring members of the other and vice versa.

The periphery of the ring members is so shaped

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as to define one or more saw teeth effective to engage, entrain and crush the materials to be crushed.

In other words the mentioned ring members form the so-called rotating knives and, due to the abrasive action thereto they are subjected during the crushing operation, said knives are easily worn.

In the known industrial crushers the mentioned ring members or rotating knives are designed and used according to different methods, which, on the other hand fall into two general types.

The first comprises the so-called single piece knives consisting of a ring member on the periphery thereof there are formed the crushing teeth, as thereinabove illustrated.

These ring members are assembled in succession, by interposing between each ring pair a suitable spacer ring effective to provide a given geometrical distance, to allow for the ring of one shaft to intermesh between those of the other.

The driving torque is transmitted by one or more keys, suitably sized and rigid with the driving shafts.

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The second type consists of the so-called sector knives which are fixed on the driving shafts therefor either by means of screws which are screwed in radially extending threaded holes, that is holes perpendicularly extending with respect to the longitudinal axes of the driving shafts, or by means of screws effective to join the knives on a surface which is tangent to and on the outside of the shaft greatest diameter, thereon there are formed suitable slots therein ridges are engaged formed on the sector inner circle arc.

Of the cited second type a variation is known therein the thereinabove mentioned sectors are provided with annular slots therein corresponding flange members can be engaged which are integrally formed with the driving shafts.

These sectors are held in place by means of radially extending cylindrical pins.

In both types the knife carrying shafts rotate as supported by suitable end bearing assemblies, which also act as joining assemblies for the longitudinal outer structures of the crusher.

A drawback which is common to both types is that of the replacing of the worn knives.

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In fact, in the first type, that is the crushers provided with single piece cutting knives, it is necessary to remove the complete shaft, while in the second type, that is the sector knife crushers, the replacing step frequently causes permanent deformations to the sector supporting and holding members, due to the high loads the latter are subjected to. In addition, also in the mentioned crushers of the second type, it is often necessary to carry out extensive adjustment operations which involve the removing of the complete driving shaft.

SUMMARY OF THE INVENTION

Accordingly the main object of the present invention is to obviate for the thereinabove mentioned drawbacks by providing a sector knife and driving shaft arrangement for crushers of the mentioned second type which is effective to allow for the sector knives to be easily removed from the driving shafts therefor, and easily replaced thereon, without the need of using specifically designed tools or skilled operators, and in a reduced time.

According to one aspect of the present invention,

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this object, as well as yet other objects which will become more apparent hereinafter, are achieved by an improved sector knife and driving shaft arrangement, characterized in that the knife consists of one or more cutting sectors, one or more spacing sectors and one locking sector effective to be inserted by a geometrical type of coupling between two of said sectors, the cutting and spacing sectors being provided with restraining means, while the driving shaft is provided with circumferential slots having restraining means mating with said cutting and spacing sector restraining means and extending through a circle arc corresponding to the difference of the corresponding circumference and the circle arc subtended by said locking sector in such a way as to leave a portion devoid of restraining means or elements, provided for the insertion therein of said cutting and spacing sectors and effective to be closed by said locking sector, means being further provided for removably fixing said locking sector to said driving shaft.

Advantageously the cutting and spacing sector restraining means consist of male dovetail shaped

restraining elements and the slot restraining means consist of female dovetail shaped restraining elements.

Preferably the cutting and spacing sector dovetail shaped restraining means are formed on the lower portions of said sectors, said cutting and spacing sectors being provided, to this end, with a bottom surface having two inwardly directed side walls, and the driving shaft slot dovetail shaped restraining means are formed by providing said slots with side walls inwardly slanted from the bottom of said slots, the portion effective to engage said locking sector being provided with straight side walls, perpendicularly extending with respect to the bottom wall.

Preferably the means for fixing the locking sector to the driving shaft consist of a pin housed in opposite seats formed on the inner surface of the locking sector and on the outside surface of the driving shaft, on the portion thereof devoid of said restraining means, and of a screw member or the like effective to be screwed in radially extending holes formed in the locking sector and driving

shaft at the bottom of the slot length or portion devoid of said restraining means.

Advantageously the pin or the like is provided with a through hole and the radially extending holes of the locking sector and driving shaft lead to the center portion of said opposite or facing seats, thereby said screw or the like is effective to pass through said pin as said screw is screwed.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in a more detailed way hereinafter with reference to a preferred embodiment thereof, being illustrated by way of an indicative and not limitative example in the accompanying drawings, where:

fig.1 is a side elevation view, partially sectioned, of the sector knife and driving shaft arrangement according to the present invention;

fig.2 is a cross-section view taken substantially along the line A-A of fig.1; and

fig.3 is a partial view of the driving shaft provided for supporting the crushing sector knives.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to fig.1 a cutting ring or knife is herein illustrated according to the present invention and the reference numbers 1, 1' and 1'' indicate the knife beak sectors, the number thereof may be obviously greater than three.

At 2 there are indicated the spacing sectors which are effective to radially locate the cutting sectors 1 depending on the use requirements; at 6 there is indicated the knife driving shaft and at 3 the locking sector which, by means of the cylindrical pin 4 is effective to support the tangential loads the cutting sectors 1 are subjected to. The screw 5 compels the locking sector to firmly engage between two adjoining members, which in the figure consist of the two beak shaped elements 1 and 1'.

Fig.2 is a cross-section view substantially taken according to a radial plane of the cutting sector 1'.

As it is clearly shown in this figure, the lower

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portion of the cutting sector is so machined as to provide two slanted surfaces or planes forming a dovetail shaped restraining section, extending through the circle arc defining the sector angular opening.

More specifically the characteristic restraining section angular opening is designed depending on the loads the sectors are subjected to during the crushing operation.

On the central cylindrical body 7 of the driving shaft 6 (fig.3) there are machined slots 8 the sides or walls 9 thereof are slanted with an angular opening identical to the mentioned angular opening of the dovetail shaped restraining sections of the cutting and spacing sectors 1 and 2 respectively.

At a circumferential zone selected at will, the slanted sides or walls 9 are removed for a suitable angular extension, symmetrically with respect to one another.

Thus a straight side or wall slot portion 10 is obtained the width thereof is precisely identical to the size of the greater side of the trapezium forming said slot.

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Into the straight wall slot portion 10 there are introduced the cutting sectors 1 and the angular spacing sectors 2, as it was thereinabove illustrated.

Thus, upon having introduced said cutting sectors 1 into said slot 10, said sectors are caused to slide to the slanted wall slot portion, therein they are held by a dovetail restraining type of coupling.

In this manner a cutting sector 1 and a spacing sector 2 are introduced, in the amounts provided for the use requirements.

In the central portion of the straight slot 10 there is housed the cylindrical pin 4, a portion thereof is held in a suitable seat or housing 11 formed on the shaft 6, while the remaining portion thereof is housed in a suitable bore 12 formed in the locking sector 3 having straight sides which extend through the overall volume of the straight wall slot.

The cylindrical pin 4 is bored according to the longitudinal axis thereof in order to allow for the screw 5 to pass through which screw traverses the locking sector 3 and is screwed in a suitable thread-

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hole 13 formed on the shaft 6.

The main force exerted on the beak shaped projecting portion 14 formed on the cutting sectors 1 and which comprises the active element for the cutting operation, has two principal operative components, that is a tangential component which tends to cause the involved sector to rotate in the slot 8 and a radial component which tends to rise said sector.

Against the tangential component reacts the pin 4, while against the radial component react the dovetail shaped restraining means. The latter, moreover, act as a cone braking shoe, and, in this manner, a portion of the tangential load is subtracted from the friction momentum due to the wedging action of the sector root into the slot 8.

Thus the opposite reaction of the pin 4 is of smaller amount, in other words it is indirectly proportional to the tangential force acting on the sector subjected to the working load.

Another important factor arising from the therein-above described construction is the homogeneity of the material comprising the cutting sectors 1, which, as

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aioresaid are the active cutting elements and then the most stressed ones.

Indeed, contrarily to the known industrial types, the described cutting sectors are not weakened in none of their sections by longitudinal holding or fixing holes or slots.

Thus any possibilities of microcracks which may occur during typical machining operations, such as the tapping of the holes, or due to internal stress differences because of thermal treatments or the like, are completely eliminated.

Moreover it is to be pointed out the great facility of replacing the worn cutting sectors, since it is simply necessary to remove the screw 5, pin 4 and locking sector 3, thereby allowing the sectors 1 and 2 to slide in the slot 8 as far as the straight wall portion 10, therefrom they may be easily removed.

In addition to the foregoing the broad restraining surfaces forming the coupling dovetails sections are effective to maintain low the compression loads, thereby assuring an absolute undeformability of the coupling geometrical shape.

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From the above it should be easily noted that the sector knife and related driving shaft arrangement substantially eliminates all of the mentioned drawbacks of the known crushing knives, in a simple way, thereby allowing for the knife to be quickly and easily removed from its driving shaft and a new knife to be quickly and easily replaced therefor, without requiring any special tools nor skilled personnel.

While the invention has been thereinabove described and illustrated with reference to a preferred embodiment thereof, it should be noted that it is susceptible to any modifications or variations falling within the scope of the appended claims.

C L A I M S

1- Sector knife and driving shaft arrangement, characterized in that the knife consists of one or more cutting sectors, one or more spacing sectors and one locking sector effective to be inserted by a geometrical type of coupling between two of said sectors, the cutting and spacing sectors being provided with restraining means, while the driving shaft is provided with circumferential slots having restraining means mating with said cutting and spacing sector restraining means and extending through a circle arc corresponding to the difference of the corresponding circumference and the circle arc subtended by said locking sector in such a way as to leave a portion devoid of restraining means or elements, provided for the insertion therein of said cutting and spacing sectors and effective to be closed by said locking sector, means being further provided for removably fixing said locking sector to said driving shaft.

2- An arrangement according to claim 1, characterized in that said cutting and spacing sector restraining means consists of male dovetail shaped restraining

elements and in that said slot restraining means consists of female dovetail shaped restraining elements.

3- An arrangement according to claim 2, characterized in that said cutting and spacing sector dovetail shaped restraining means are formed on the lower portions of said sectors, said cutting and spacing sectors being provided with a bottom surface having two inwardly directed side walls, and in that said driving shaft slot dovetail shaped restraining means are formed by providing said slots with side walls inwardly slanted from the bottom of said slots, the portion effective to engage said locking sector being provided with straight side walls, perpendicularly extending with respect to the bottom wall.

4- An arrangement according to claim 1, characterized in that said means for fixing said locking sector to said driving shaft consist of a pin housed in opposite seats formed on the inner surface of said locking sector and on the outside surface of said driving shaft, on the portion thereof devoid of said restraining means, and of a screw member effective to be screwed in radially extending holes

formed in said locking sector and driving shaft at the bottom of the slot length devoid of said restraining means.

5- An arrangement according to claim 4, characterized in that said pin is provided with a through hole and in that the radially extending holes of said locking sector and driving shaft lead to the center portion of said opposite or facing seats, thereby said screw is effective to pass through said pin as said screw is screwed.

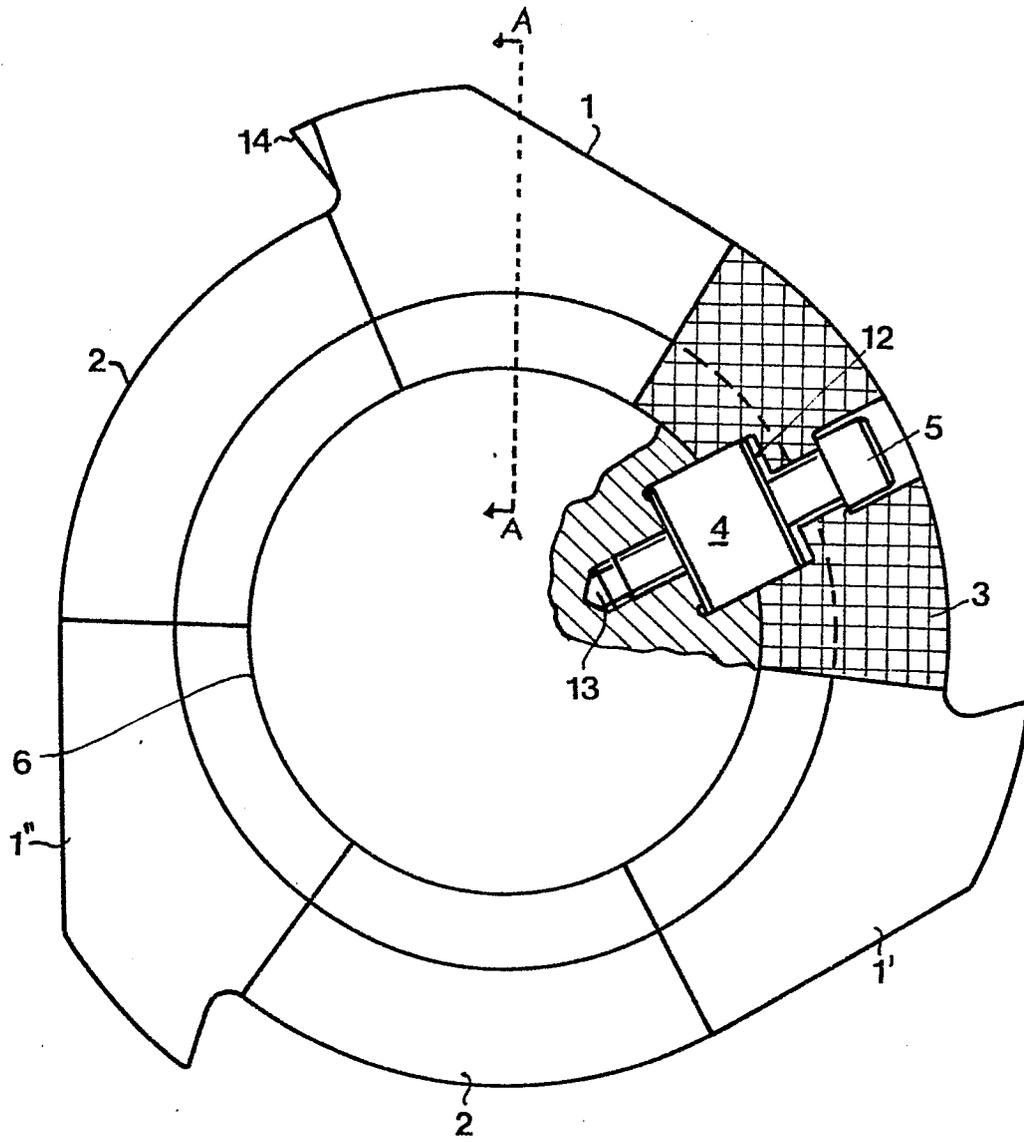


FIG 1

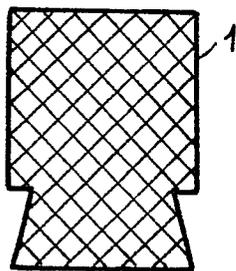
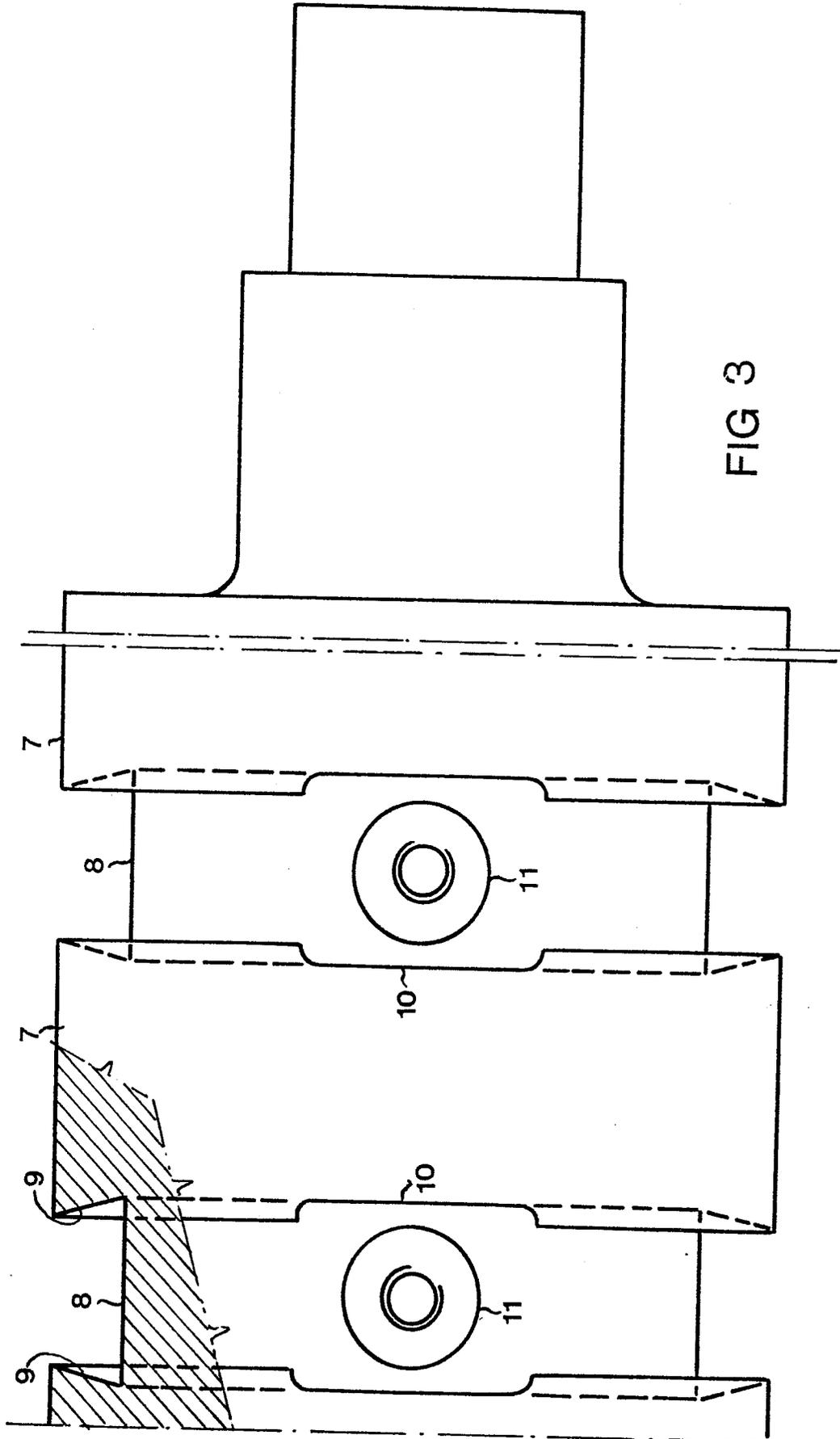


FIG 2

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0093223





European Patent
Office

EUROPEAN SEARCH REPORT

0093223

Application number

EP 82 83 0116

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	<p style="text-align: center;">---</p> EP-A-0 006 261 (BAIKOFF) *Page 1; claims 1,2,3*	1	B 02 C 18/18
A	<p style="text-align: center;">---</p> FR-A-2 257 346 (BAIKOFF) *Page 14, lines 37-38; page 15, lines 1-25*	1	
A	<p style="text-align: center;">---</p> GB-A-2 024 655 (METAL BOX) *Page 4, lines 58-68*	1	
A	<p style="text-align: center;">---</p> US-A-1 750 941 (PARDEE) *Page 1, lines 96-100; page 2, lines 10-20,47-59,82-96*	1	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 02-12-1982	Examiner VERDONCK J.C.M.J.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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