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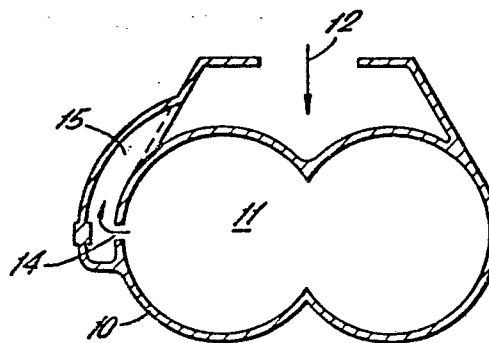
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54 Improvements in screw compressors.

57 A meshing screw compressor comprises a casing (10) in which there is defined a working chamber (11), a fluid inlet (12) and a fluid outlet. The working chamber (11) is periodically in fluid communication with the inlet (12) and the outlet and is situated therebetween. Fluid is compressed in the working chamber (11) under the interaction of the meshing screws therein in passing from the inlet (12) to the outlet. The casing (10) incorporates a discharge arrangement (14) between the inlet (12) and the outlet, the discharge arrangement (14) being in permanent fluid communication with the working chamber (11). The discharge arrangement (14) allows fluid to bleed from the working chamber (11) and is prearranged to provide a fixed rate of fluid bleed from the working chamber (11) at a constant running speed of the compressor. The discharge arrangement (14) communicates with a passageway (15) formed integrally in the casing (10) to allow fluid bled from the working chamber (11) to return to the inlet (12).

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1. The invention relates to a meshing screw

type compressor, comprising a casing, a fluid inlet and a fluid outlet, the

casing having a working chamber defined therein, the working chamber being periodically in fluid communication

with the inlet and outlet and situated therebetween,

the fluid being compressed within the working chamber

IMPROVEMENTS IN SCREW COMPRESSORS

This invention relates to a meshing screw type compressor.

5 Meshing screw type compressors comprising a casing, a fluid inlet and a fluid outlet, the casing having a working chamber defined therein, the working chamber being periodically in fluid communication with the inlet and outlet and situated therebetween, 10 the fluid being compressed within the working chamber under the interaction of meshing screws therein in passing from the inlet to the outlet, are herein referred to as compressors "of the kind described".

In application, a meshing screw compressor 15 of the kind described is commonly matched with a suitable motor running at a prescribed fixed speed, the motor being directly coupled to one of the compressor screws. It is to be expected that a wide variety of compressor applications will be required at a 20 prescribed fixed speed for which the power input requirement will be different for different discharge

pressure conditions and the problem then is to find, for a particular duty, a suitable power match between a selected compressor and one of a standard range of motors.

Various attempts have been made to provide
5 compressors of the kind described with variable fluid output characteristics.

For example, British Patent Specification No. 1518271 describes a method for increasing the compression ratio of a standard compressor without any substantial
10 increase in power input requirement. According to this method, the inlet port of the compressor is enlarged, the enlarged portion extending into the compression zone of the compression chamber to reduce the volumetric capacity of the compressor
15 and hence increase its compression ratio. The modification can be carried out by a cutting operation performed on a standard compressor, the cutting operation becoming increasingly complex the greater the increase in compression ratio is
20 required. In addition, the size of the outlet port can be reduced for achieving the maximum increase in compression ratio. Alternatively, the cutting operation can be replaced by making adjustments to the casting model of standard compressors.

In practice, the method described can be costly and of necessity involves irrevocably modifying a standard compressor, the technique further being unsuitable for providing compressors with a diverse range of output characteristics without a costly variety of production.

According to the disclosure in British Patent Specification No.1576230, a compressor of the kind described has means whereby its input power requirement can be reduced to provide an energy saving for its drive motor during the idling operation and in the start-up procedure of the compressor. The means comprises a port or ports in the compression chamber of the compressor, operable by means of one or more shut-off devices, for the passage of fluid from the compression chamber back to the inlet chamber, or to the free atmosphere. By activation of the shut off devices, the port or ports can be opened during the start-up procedure or in the idling operation of the compressor allowing a substantially uncompressed volume of fluid to be released from the working chamber thereby reducing the power consumption of the compressor. However, the ports are closed during normal running of the compressor.

Compressors built according to this known design involve a substantial increase in manufacturing costs over standard compressor designs without providing any greater variety of fluid output capacities obtainable from a range of compressors available as standard. Disclosed in British Patent Specification No.1517156, is a compressor of the kind described having means by which its volumetric capacity can be adjusted whilst being driven at a fixed rotational speed by a motor. The means comprises a number of by-pass channels situated in the compression chamber which provide adjustable communication between the compression chamber and the inlet chamber of the compressor by means of control valves associated with the by-pass channels. The amount of fluid being bled off the compression chamber through the by-pass channels, and hence the volumetric capacity of the compressor, can be adjusted by either automatic or manual activation of the control valves. Compressors built to this design necessarily involve complex production techniques associated with high manufacturing costs.

It is an object of the present invention to overcome the foregoing disadvantages simply and inexpensively. This object is achieved in that there is provided a meshing screw compressor comprising a

casing, a fluid inlet and a fluid outlet, the casing having a working chamber defined therein, the working chamber being periodically in fluid communication with the inlet and the outlet and situated therebetween, the fluid being compressed within the working chamber under the interaction of meshing screws therein in passing from the inlet to the outlet, characterised in that the casing has discharge means therein in permanently open fluid communication with the working chamber to allow fluid to bleed from the working chamber through the discharge means between the inlet and the outlet, in which the discharge means is prearranged to provide a fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor.

The discharge means may comprise an opening in a wall of the casing having closure means associated therewith for determining a fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor.

The closure means may comprise an insert having a hole therethrough, the insert being received within the opening so that the hole therein is in fluid communication with the working chamber,

the fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor being determined by the size of the hole in the insert.

5 The closure means may comprise a plug mounted on the casing adjacent the opening, the fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor being determined by the gap between the plug and the opening.

10 The closure means may comprise a plug mounted on the casing adjacent the opening, the plug having a portion thereof which extends into the opening, the fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor being
15 determined by the annular clearance between said portion of the plug and the opening.

 The discharge means is preferably in fluid communication with the fluid inlet so that fluid bleeding off the working chamber, in use, passes
20 from the working chamber back to the fluid inlet.

 A passageway is preferably formed integrally within a wall of the casing, the passageway being in fluid communication between the discharge means and the fluid inlet to allow fluid bleeding off
25 the working chamber, in use, to pass through the passageway back to the inlet.

 The discharge means is preferably situated adjacent the fluid inlet end of the working chamber

so that fluid bleeding off the working chamber, in use, has not been substantially compressed.

By way of example, a meshing screw compressor and four embodiments of a discharge arrangement therefor according to the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 shows a schematic layout of a meshing screw compressor according to the present invention,

Figure 2 shows a cross-sectional end view of a compressor having a first embodiment of a discharge arrangement according to the invention,

Figure 3 shows a fragmentary cross-sectional side view of a modified passageway for a compressor having the first embodiment of a discharge arrangement,

Figure 4 shows an enlarged fragmentary cross-sectional side view of the first embodiment of a discharge arrangement shown in Figures 2 and 3,

Figure 5 shows an enlarged fragmentary cross-sectional side view of a second embodiment of a discharge arrangement according to the invention,

Figure 6 shows an enlarged fragmentary cross-sectional side view of a third embodiment of a discharge arrangement according to the invention, and

Figure 7 shows an enlarged fragmentary cross-sectional side view of a fourth embodiment of a discharge arrangement according to the invention.

In the drawings, Figures 1, 2 and 3 show a compressor having a casing 10 in which is defined a working chamber 11. A pair of meshing screws is

situated in the working chamber 11 and one of the meshing screws is coupled to a motor which thereby drives the compressor. Fluid enters the working chamber 11 from a fluid inlet 12, with or without the use of fluid injection, and is compressed under the interaction of the meshing screws within the working chamber 11. The compressed fluid then passes out through a fluid outlet 13. A fluid discharge arrangement 14 is provided in a wall of the casing 10, in permanently open fluid communication with the working chamber 11, to allow fluid to bleed from the working chamber 11 in use. A passageway 15, formed integrally in the casing 10, intercommunicates the discharge arrangement 14 with the fluid inlet 12 so that fluid bleeding from the working chamber 11 returns to the fluid inlet 12 in use.

The passageway 15 can be formed circumferentially on the casing 10 for communication with a fluid inlet 12 positioned on the top of the casing 10 as shown in Figure 2. Alternatively, the passageway 15 can be formed axially on the casing 10 for communication with a fluid inlet 12 positioned at the end of the casing 10, as shown in Figure 3.

It is desirable that the discharge arrangement 14 is situated towards the fluid inlet end of the working chamber 11 in order that the fluid bleeding from the working chamber 11, in use, has not been substantially compressed.

In the first embodiment of a discharge arrangement 14, shown in Figure 4, a hole 16 is drilled through the casing 10 to provide permanently open fluid communication between the working chamber

11 and the passageway 15. This hole 16 is conveniently drilled from the outside of the casing 10 and the hole 17 thereby formed in the outer wall 18 of the passageway 15 is plugged to seal off the passageway 15 from the free atmosphere. In Figure 4, the hole 17 is shown as a tapped hole in which is received a threaded plug 19, but it will be appreciated that other forms of plugging the hole 17 could be employed. In the first embodiment of a discharge arrangement, as shown in Figure 4, the rate of fluid bleed from the working chamber at a constant running speed of the compressor is determined by appropriate selection of the size of the hole 16 in the casing 10.

15 In a second embodiment of a discharge arrangement 14, shown in Figure 5, a hole 20 is drilled into the casing 10 to interconnect the passageway 15 with the working chamber 11. The hole 20 is tapped to receive a threaded insert 21. The insert 20 21 has a hole 22 therethrough for providing permanently open intercommunication between the working chamber 11 and the passageway 15 when the insert 21 is received in the hole 22. Here again, the hole 20 is conveniently drilled from the outside

of the casing 10, the hole 23 thereby formed in the outer wall 18 of the passageway 15 being plugged to seal off the passageway 15 from the free atmosphere.

Again; the hole can be plugged in a number of ways as

5 previously mentioned with reference to Figure 4. In this embodiment shown in Figure 5, the rate of fluid bleed from the working chamber at a constant running speed of the compressor is determined by appropriate selection of the size of the hole 22 in the insert 21.

10 In a third embodiment of a discharge arrangement 14, shown in Figure 6, a hole 24 is drilled into the casing 10 to provide permanently open fluid communication between the passageway 15 and the working chamber 11. The hole 24 is again
15 conveniently drilled from the outside of the casing 10, thereby forming a hole 25 in the outer wall 18 of the passageway 15. A plug 26 having a threaded flange at one end and a smaller diameter plain shank at the other is received within the hole 25.

20 The hole 25 has a plain bore portion 27 which is dimensioned to suit the shank of the plug 26, and a counterbored and tapped portion 28 in which the threaded flange of the plug 26 is threadedly received. A washer 29 is interposed between a
25 seat in the hole 25, formed at the junction of the two

portions of the hole 25, and the shoulder of the flanged portion of the plug 26. The end of the plain shank of the plug 26 is chamfered and is disposed adjacent the hole 24 which intercommunicates the working chamber 11 with the passageway 15. The rate of fluid bleed from the working chamber 11 to the passageway 15 at a constant running speed of the compressor in this embodiment shown in Figure 6, is determined by the proximity of the chamfered end of the plug shank relative to the hole 24.

It will be understood that by inserting washers of different thickness into the hole 25, the proximity of the chamfered end of the plug shank relative to the hole 24 can be altered for selection of a desired bleed rate. Alternatively or additionally, plugs having shanks of different lengths could be employed for this purpose without the need of a washer.

In a fourth embodiment of a discharge arrangement 14, shown in Figure 7, a hole 32 is drilled into the casing 10 to provide permanently open fluid communication between the passageway 15 and the working chamber 11. The hole 32 is again conveniently drilled from the outside of the casing 10, thereby forming a hole 31 in the outer wall 18 of the passageway 15. The hole 31 is tapped to receive a plug 33. The plug 33 has a threaded flange at one end which is threadedly received in the hole 31 and a smaller diameter plain shank 34 at the other end which extends into the hole 32. The rate of fluid bleed from the working

chamber 11 to the passageway 15 at a constant running speed of the compressor in this embodiment, shown in Figure 7, is determined by the annular clearance between the plug shank 34 and the hole 32. Clearly the plug shank 34 need not necessarily have a circular cross-section but it is important that the plug shank 34 in the embodiment does not extend into the working chamber 11 and hence foul the meshing screws. For this purpose, a further flange 35 may be provided on the plug 33, for example, to limit the depth of penetration of the plug shank 34 into the hole 32, although it will be appreciated that a number of other ways of thus locating the plug 33 could be used.

It will be appreciated that whilst it is preferred to return the fluid bleeding from the working chamber back to the fluid inlet, particularly if the working fluid is anything other than air, it is not essential to the invention; the fluid bleed could equally well be allowed to discharge to the free atmosphere, for example, or it could be directed to some external collection point.

It will also be appreciated that although the bleed communication between the working chamber and the fluid inlet as shown in Figures 2, 3, 4, 5, 6 and 7 of the drawings takes the form of a passageway formed integrally within the casing, other forms of bleed communication could be provided. A pressure line, for example, could be coupled between the discharge

arrangement and a point in the fluid inlet to provide fluid communication between the working chamber and the fluid inlet.

5 Figures 4, 5, 6 and 7, showing the four
embodiments of a discharge arrangement according
to the invention, each show only one opening for
providing permanently open fluid communication between
the working chamber and the passageway. It will
be understood, however, that any number of such
10 openings could be provided in the casing and the
openings may be of different sizes. Indeed, giving
consideration to production line operations in the
manufacture of compressors according to this invention,
it may be desirable to provide a number of such
15 openings in each unit as a standard operation.
The desired rate of fluid bleed from each standard
compressor off the production line could thus be
determined by plugging off a suitably selected
combination of openings in the discharge arrangement.

20 ' It will also be appreciated that whilst the
openings in the casing are conveniently drilled
from the outside of the casing, rendering the closure
means externally accessible, other means for providing
such openings could be used. Openings could be
25 drilled into the casing from the inside of the
working chamber, for example, or such openings could
be provided by holes formed in the casing as an
integral part of the casting.

It is also considered preferable for the discharge arrangement to be rendered as tamper-proof as possible so that the fixed rate of fluid bleed determined for a particular compressor during manufacture cannot easily be adjusted subsequently.

It can be seen from the description of each of the four embodiments according to the invention shown in Figures 4, 5, 6 and 7 that an infinite variety of permutations is possible for determining a fixed fluid bleed rate from a compressor. This is an important feature when attempting to find an ideal match between a compressor and a standard motor.

A major advantage of this invention, therefore, is that an extensive range of fluid output capacities is available from compressors built according to the invention at a minimal cost in terms of deviating from present manufacturing production and that the invention is extremely sympathetic to standardisation of parts and production line operations.

CLAIMS

1. A meshing screw compressor of the kind comprising
a casing (10), a fluid inlet (12) and a fluid outlet
(13), the casing (10) having a working chamber (11) de-
5 fined therein, the working chamber (11) being periodically
in fluid communication with the inlet (12) and the outlet
(13) and situated therebetween, the fluid being compressed
within the working chamber (11) under the interaction of
meshing screws therein in passing from the inlet (12) to
10 the outlet (13), characterised in that the casing has
discharge means (14) therein in permanently open fluid
communication with the working chamber to allow fluid to
bleed from the working chamber through the discharge
means between the inlet and the outlet, in which the
15 discharge means is prearranged to provide a fixed rate
of fluid bleed from the working chamber at a constant
running speed of the compressor.

2. A meshing screw compressor as claimed in Claim
20 1 characterised in that the discharge means comprises
an opening (16) in a wall of the casing, the fixed rate
of fluid bleed from the working chamber at a constant
running speed of the compressor being determined by the
size of the opening.

25 3. A meshing screw compressor as claimed in Claim
1 characterised in that the discharge means comprises an
opening (20, 24, 32) in a wall of the casing having closure

means (21, 26, 33) associated therewith for determining a fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor.

5 4. A meshing screw compressor as claimed in Claim 3 characterised in that the closure means comprises an insert (21) having a hole (22) therethrough, the insert being received within the opening (20) so that the hole therein is in fluid communication with the working chamber,
10 the fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor being determined by the size of the hole in the insert.

5. A meshing screw compressor as claimed in Claim 15 3 characterised in that the closure means comprises a plug (26, 33) mounted on the casing adjacent the opening (24, 32), the fixed rate of fluid bleed from the working chamber at a constant running speed of the compressor being determined by the gap between the plug and the
20 opening.

6. A meshing screw compressor as claimed in Claim 3 characterised in that the closure means comprises a plug (33) mounted on the casing adjacent the opening
25 (32), the plug having a portion (34) thereof which extends into the opening, the fixed rate of the fluid bleed from the working chamber at a constant running

speed of the compressor being determined by the annular clearance between said portion of the plug and the opening.

5 7. A meshing screw compressor as claimed in any preceding claim characterised in that the discharge means (14) is in fluid communication with the fluid inlet (12) so that fluid bleeding off the working chamber (11), in use, passes from the working chamber back to the fluid
10 inlet.

 8. A meshing screw compressor as claimed in Claim 7 characterised by a passageway (15) formed integrally within a wall of the casing (10), the passageway being
15 in fluid communication between the discharge means (14) and the fluid inlet (12) to allow fluid bleeding off the working chamber (11), in use, to pass through the passageway back to the inlet.

20 9. A meshing compressor as claimed in any preceding claim characterised in that the discharge means (14) is situated adjacent the fluid inlet end of the working chamber (11) so that fluid bleeding off the working chamber, in use, has not been substantially compressed.

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FIG. 1.

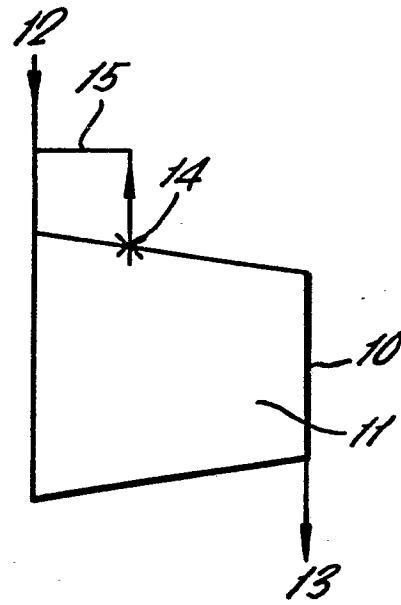


FIG. 2.

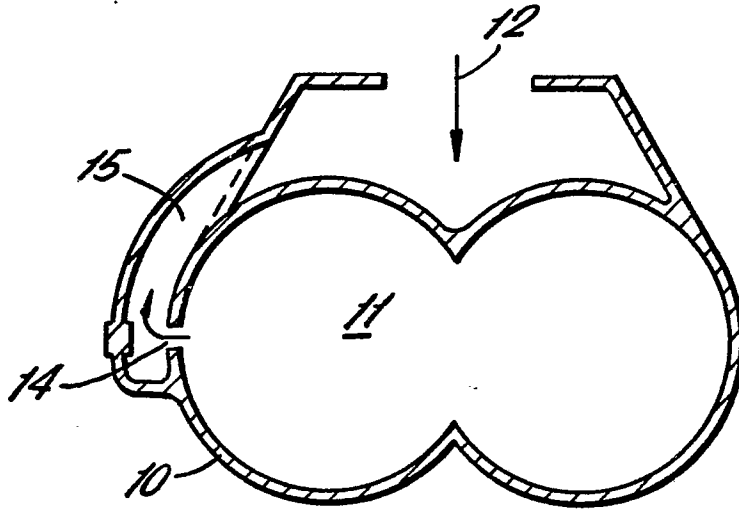
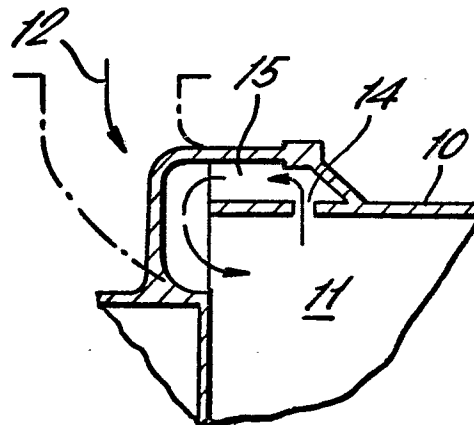


FIG. 3.



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FIG. 4.

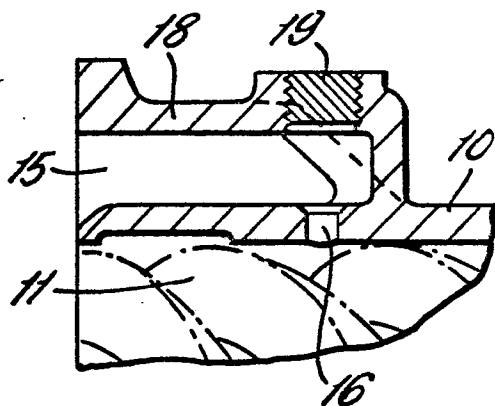


FIG. 5.

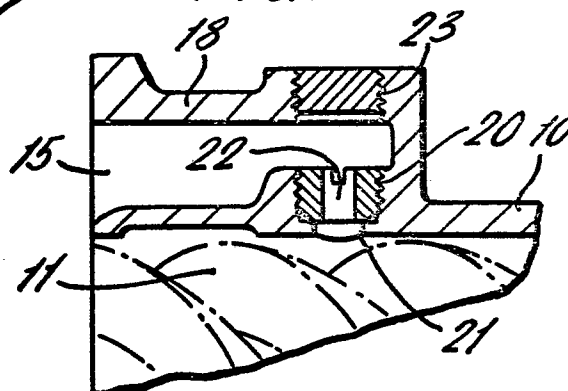


FIG. 6.

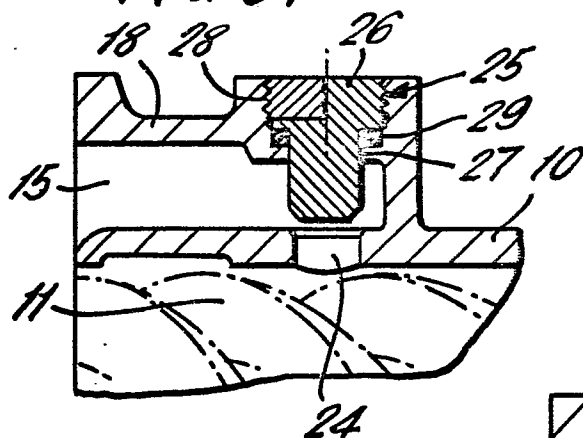
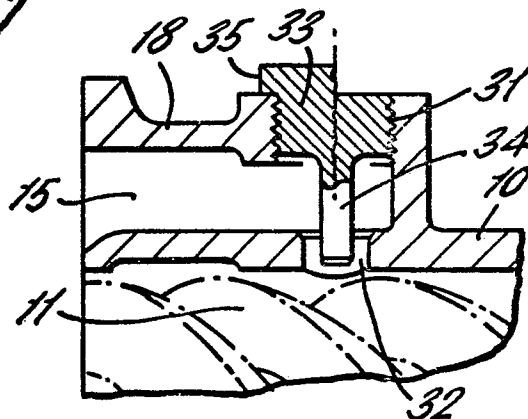


FIG. 7.





European Patent
Office

EUROPEAN SEARCH REPORT

0060639
Application number

EP 82 30 1011

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)
D, Y	GB-A-1 576 230 (AERZENER MASCHINENFABRIK) * page 1, lines 33 to 55, last paragraph; page 2, lines 1 to 29, 42 to 57, 72 to 75; figures 1, 2 *	1, 2, 7, 8, 9	F 04 C 18/16 F 04 C 29/10
Y	FR-A-1 303 685 (STUDIA TECHNICA) * page 1, right-hand column, lines 15 to 20; figure 1; page 2, left-hand column, paragraphs 2, 3, 4; right-hand column, lines 14 to 37; figures 2, 3, 4 *	1, 2, 3, 5, 7, 8	
Y	GB-A- 420 501 (SULZER FRERES) * page 1, last paragraph; page 2, left-hand column, right-hand column, two first paragraphs; figure 1 *	1, 3, 5, 7, 8	
A	US-A-2 623 469 (GRAY)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3) F 04 C F 01 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24-06-1982	Examiner KAPOULAS T.
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			