Oct. 14, 1941. R. HASENZAHL 2,258,649

INTERNAL COMBUSTION ENGINE

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Fig. 6.

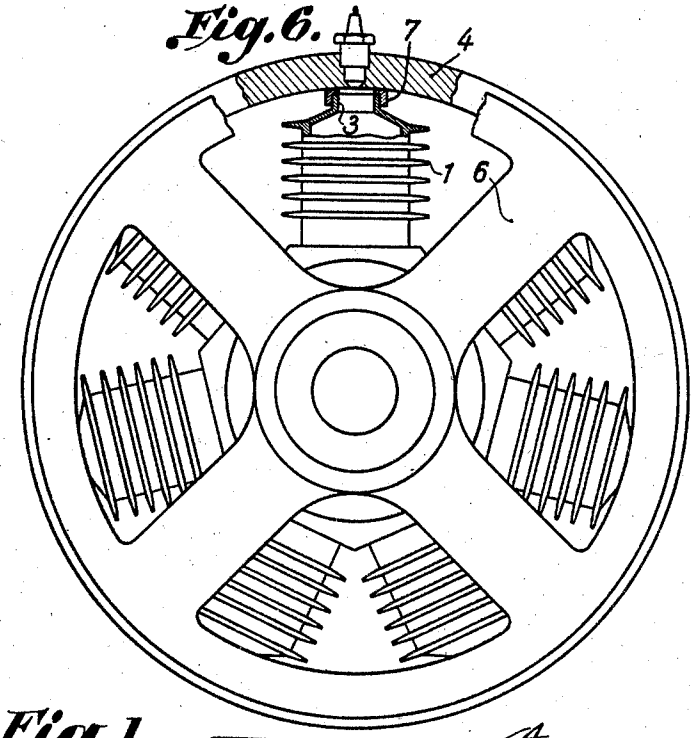
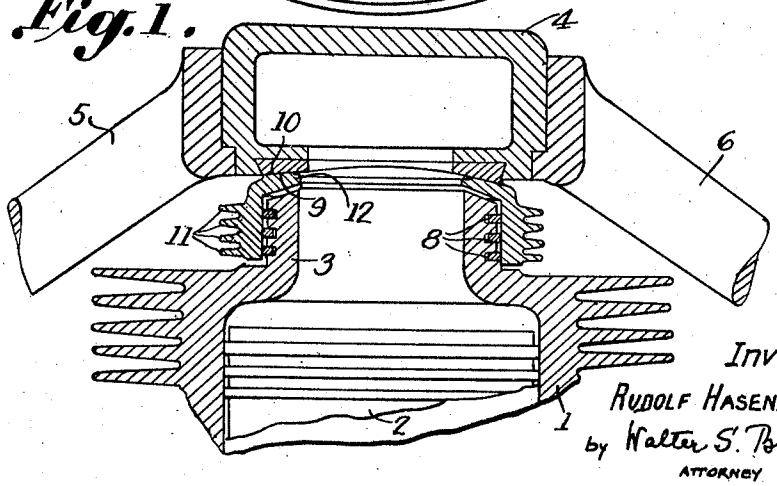



Fig. 1.




Inventor:
RUDOLF HASENZAHL
by Walter S. Poleston
ATTORNEY

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Fig. 2.

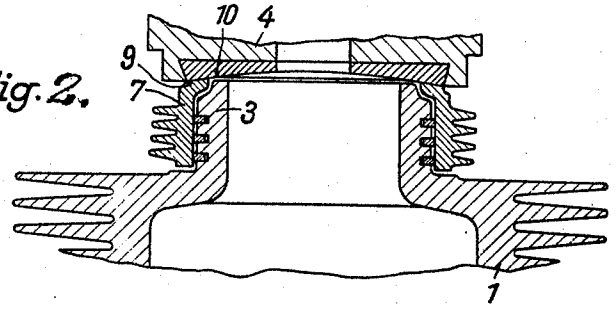



Fig. 3.

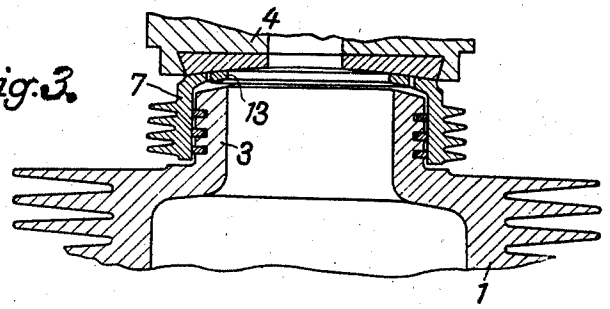



Fig. 4.

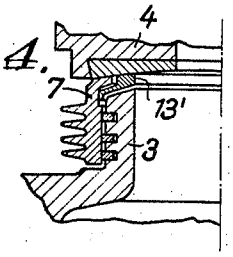
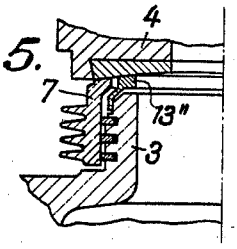



Fig. 5.




Inventor:
Rudolf Hasenzahl
by Walter S. Bleistein
ATTORNEY

Patented Oct. 14, 1941 2,258,649

# UNITED STATES PATENT OFFICE

2,258,649

## INTERNAL COMBUSTION ENGINE

Rudolf Hasenzahl, Dessau, Germany, assignor to Gotthard Sachsenberg Zentralgesellschaft mit beschränkter Haftung, Berlin, Germany, a German society

Application February 4, 1939, Serial No. 254,577
In Germany February 5, 1938

3 Claims. (Cl. 123—44)

This invention relates to an explosion or internal combustion engine having a plurality of rotating or stationary cylinders arranged in star shape and controlled by an annular slide valve, provided with suitable suction and exhaust ports.

In engines of the type referred to, the said cylinders and the said annular slide valves have periodically communicated to them a relative motion in such a manner that the openings in the slide valve and the corresponding openings in the cylinders register at times corresponding to the strokes or cycles. Thus, at the suction stroke and exhaust stroke one opening respectively of the annular slide valve registers with an opening in one of the cylinders corresponding to the stroke, while during the compression stroke and the combustion the openings in the cylinders are covered by the full portions of the slide valve.

Combustion engines of the said type are described and illustrated, for example, in United States Letters Patent 1,915,582, and it is pointed out in said patent that the packing between the annular slide valve and the cylinders must be as perfect as possible. The present invention has particular reference to the portions of the engine where said packing problem arises.

In the known engines with annular slide valve the packing is effected by cylindrical slide bodies which are guided on the inner faces of contracted neck portions or combustion chambers at the cylinder heads and with their outer end faces engage the seat surface of the said annular slide valve under action of the centrifugal force, the gas pressure or other suitable forces.

It is one of the objects of the invention to provide a design and construction of the neck portions and packing members of the cylinders which while ensuring a reliable packing action provide more favourable thermodynamic conditions in the combustion chambers of the cylinders and a more favourable shape of the same.

Another object of the invention is to enhance the life of the slide bodies or packing members.

With these and other objects in view, as may become apparent from the within disclosures, the invention consists not only of the structures herein pointed out and illustrated but includes further structures coming within the scope of what hereinafter may be claimed.

The character of the invention, however, may be best understood by reference to certain of its structural forms, as illustrated by the accompanying drawings in which—

Fig. 1 is a fragmentary axial section through a cylinder and cooperating annular slide valve of an internal combustion engine having the invention applied thereto.

Fig. 2 is a modification of Fig. 1.

Figs. 3 to 5 are similar views, showing further modified embodiments of the invention.

Fig. 6 is a diagrammatical front elevation partly in section of an engine with cylinders arranged in star shape, and including a structure similar to that of Fig. 1.

Similar reference numerals denote similar parts in the different views.

Referring now to the drawings in greater details, and first to Fig. 1, an air-cooled cylinder 1 with cooling ribs cooperates with a piston 2 and is formed with a contracted combustion chamber or neck portion 3 adjacent to the inner surface or seat of an annular slide valve 4 which is carried by a plurality of arms 5 and 6 arranged in star shape at both sides of the rim or ring 4, with the center axis of the star or stars coinciding with the center axis about which the cylinders 1 which are also arranged star-fashion, rotate or are stationarily positioned, respectively. The general arrangement of the cylinders and annular slide valve is shown in Fig. 6. In the embodiment of Fig. 1, a packing member 7 is provided which is guided on an outer cylindrical surface of the combustion chamber and leaves the interior space within the contracted neck portion or combustion chamber 3 entirely unaffected. In other words, the arrangement is such that the inner cylindrical surface of said neck portion is freely exposed to the action of the combustion gases without parts or portions of the packing means covering said surfaces or substantial parts thereof. Packing rings 8 of the kind used as piston rings are received in annular grooves of the exterior cylindrical surface of the neck portion 3 to ensure smooth sliding and good packing action of the member 7 on the neck portion of the cylinder. The member 7 is moreover formed with an inner flange portion the end face 9 of which is curved to engage tightly the circular seat face 10 within the slide valve ring 4, under action of the centrifugal force and/or of the gas pressure and/or of springs (not shown). Generally, springs will not be required unless the cylinders are stationary and the ring 4 rotates; normally, however, the design with rotating cylinders and stationary ring 4 will be the preferred construction.

It will thus be understood that a tight connection is established between the cylinder 1 and the ports in the valve ring 4 by the member 7, while the inner cylindrical walls of the combustion chamber 3 are entirely free from any portions of the packing member 7. It has been found that this construction is very much superior, from a thermodynamic standpoint, to the known construction with packing members having portions extending into the combustion chamber. Due to the fact that the inner walls of the combustion chamber are not covered by parts or portions of

the packing member, a very favourable shape of the same is obtained and the heat can be more efficiently transmitted from the walls of the combustion chamber to the outside, for example, through the cooling ribs of the cylinders. Moreover, the life and packing effect of the packing member is greatly enhanced due to the fact that the same is not exposed to the direct action of the heat in the combustion chamber. The fundamental difference compared to one known construction in which the packing member embraces or engages both the inner and outer face of the neck portion of the cylinder resides in the fact that in the said known construction while outer packing portions are provided, there are still portions of the packing means located in the combustion chamber within the neck portion of the cylinder and guided at the inner wall thereof so that the combustion chamber is not unaffected by portions of the packing member and therefore, the above mentioned drawbacks caused thereby are produced in this case as well.

Due to the special arrangement of my novel packing member it is possible to provide additionally cooling ribs at the packing members. Moreover, the end face 9 of the packing member 7 may be sphercially shaped, and the valve ring 4 may be formed hollow as shown, and provided with a separate member secured to the valve ring dove tail fashion for forming the spherical surface 10; which the packing member will tightly engage in any turned position. Moreover, in order to reduce the amount of clearance between the end face of the cylinder neck 3 and the inner face of the packing member 7 which clearance is required in order to render possible the assemblage of the cylinders within the valve ring 4, and is determined by the rising of the sphere portion formed by the faces 9 and 10, the surface 9 may be made relatively narrow, with an inner diameter which is larger than the inner diameter of the portion 3, and continued by an inner flange portion which is formed with one or more axially projecting and recessed rings or combs, as indicated at 12 in Fig. 1, to form a kind of a labyrinth packing system and to cause a throttling effect for the compressed gas tending to escape between the packing faces 9 and 10. Due to the smaller width of the packing face 7 thus obtained the said rising of the sphere portion is also reduced and the clearance may be smaller. This structure offers the additional advantage of protecting the inner edge of the flange surface 9 from the direct attack of the combustion gases.

A further throttling effect and protection of the inner edge of the annular face 9 may be obtained, as shown in Fig. 2, by forming the neck portion 3 with a projection extending nearly to the packing surface 10, with a very small gap therebetween. In this case, the inner diameter of the packing member 7 at the innermost point of engagement with the packing face 10 is substantially larger than the inner diameter of the neck portion 3.

It is also contemplated that an auxiliary packing ring may be provided in the gap left in axial direction between the face 10 of the valve ring 4 and the end face of the neck portion 3, as indicated at 13 in Fig. 3. Preferred constructions of this general type are shown in Figs. 4 and 5. In Fig. 4, a packing ring 13' of Z-shape is slidably guided on an inner cylindrical face of the packing member 7 while in Fig. 5 a similar ring 13'' is slidably guided on an outer cylindrical face of the neck portion 3. It will be clear that rings of the type shown at 13, 13' and 13'', respectively, form a bar for the gas tending to escape and throttle down the pressure of the gas before it reaches the packing rings while simultaneously protecting the inner edge of the flange face of member 7.

It will be noticed that in consequence of the improved heat transmission from the combustion chamber obtained by my novel construction the output of the engine can be increased and the durability of the packing member which in this case is not exposed to the direct heating action of the combustion gases can be increased.

Also, the packing member is not distorted by such excessive heating action and the packing rings cannot get stuck by deposits of carbon or thermal expansions and, therefore, a more reliable packing effect is obtained.

Furthermore, the combustion chamber within the neck portion is not affected or deformed by parts or portions of the packing member and therefore, it can be made to have a simple, smooth and favourable shape.

I am aware that many further changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than is necessitated by the prior art.

I claim:

1. In an internal combustion engine having cylinders arranged in star shape, a port in the head of each of the cylinders arranged in a reduced neck portion thereof, an annular slide valve having ports therein for controlling the intake and exhaust of said cylinders, packing means including exterior cooling ribs and an inwardly turned flange with an annular surface adapted to engage the seat surface of said slide valve, said packing means being slidably disposed on exterior guiding surfaces of said neck portion, and means for protecting the inner edge of said annular flange surface from the direct attack by combustion gases, the inner surface of said neck portion being freely exposed to the action of the combustion gases without parts or portions of the packing means covering said surface or substantial parts thereof.

2. In a device of the type described, a packing means comprising a substantially cylindric body having interior sliding and exterior cooling surfaces and including an inwardly turned flange, said flange having an annular front surface adapted to seat on a valve member, and an auxiliary substantially ring-shaped member interiorly of said flange and movable independently thereof, said auxiliary member having a front face adapted to engage the same valve member as said flange, so as to protect the inner edge of said annular surface of said flange against the action of streaming combustion gases.

3. A packing device as claimed in claim 2, in which said auxiliary ring includes a rearward cylindric projection, said projection being guided within said cylindric body.

RUDOLF HASENZAHL.