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F. GOSSLAU
MOTOR WITH CYLINDERS ARRANGED IN ROWS IN V-FASHION
Filed Nov. 6, 1939

Serial No.
303,121
3 Sheets-Sheet 1

Fig.1

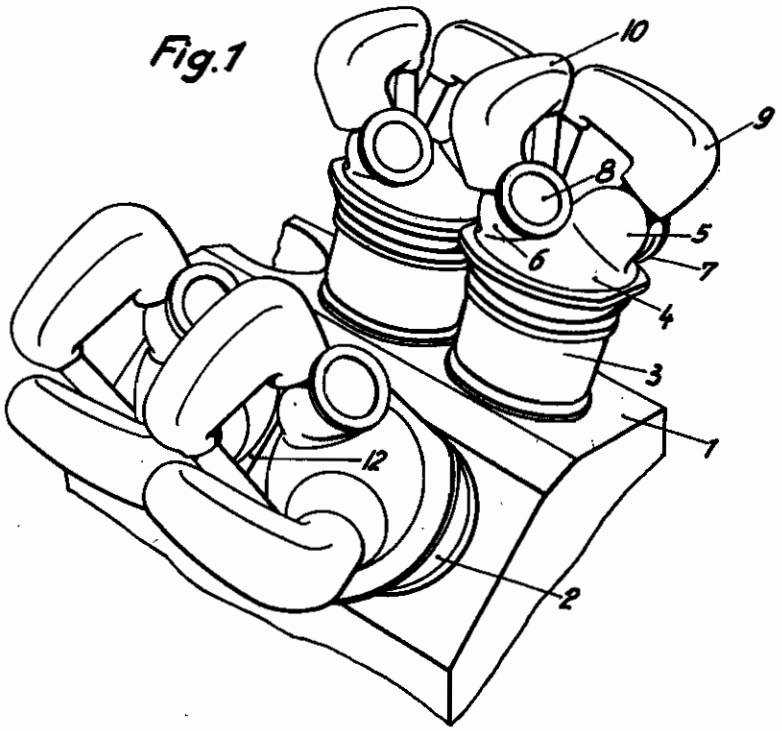

Fig.2

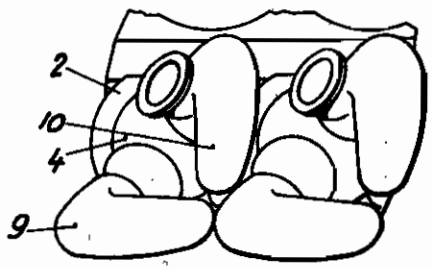

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Fig. 3

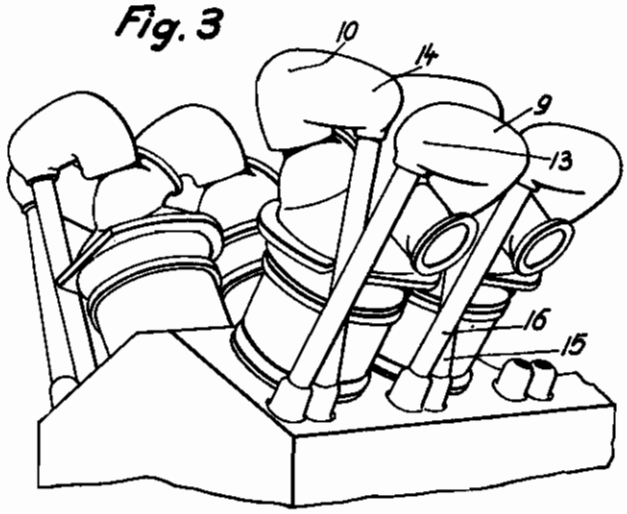

Fig. 4

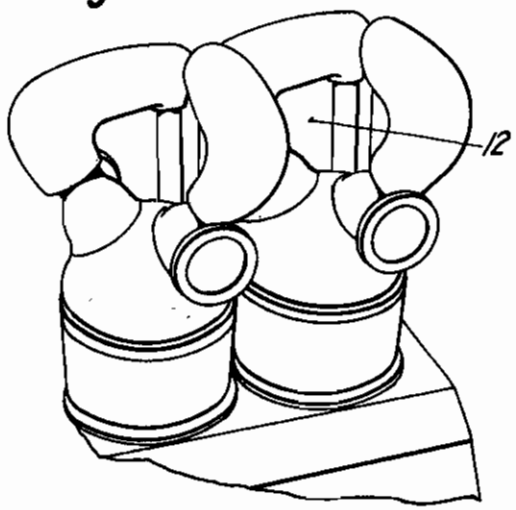

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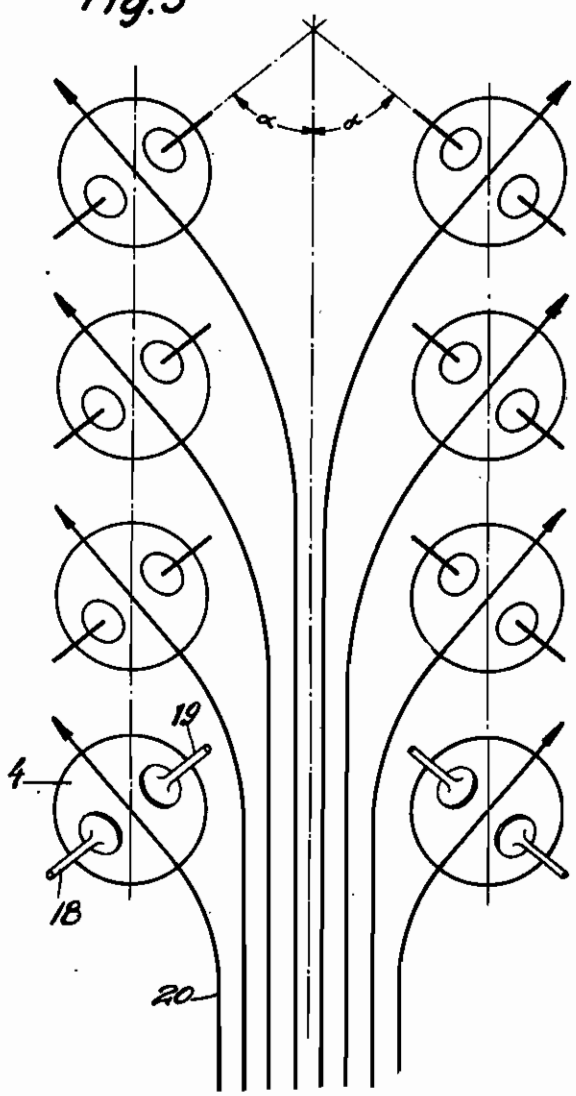
Fig. 5



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ALIEN PROPERTY CUSTODIAN

MOTOR WITH CYLINDERS ARRANGED IN ROWS IN V-FASHION

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Application filed November 6, 1939

The present invention relates to a motor having cylinders arranged in rows and set at an angle to the crank shaft in V-fashion. Each cylinder of the motor according to the invention being provided with a combustion space of approximately the shape of a spherical segment and the admission- and exhaust valves of each cylinder enclosing an angle of more than 35° and a plane passing through both valve axes of each cylinder forming an angle with the axis of the crank shaft of at least 5° and at the most 85°.

The motor according to the invention thereby combines the advantages of a star-connected motor—usability of the spherical head with large valves and best cooling—with those of a motor having cylinders arranged in rows and set in V-fashion—low head resistance, good sight and compact construction—and therefore represents a substantial improvement of the already highly developed air cooled motors having cylinders arranged in rows and set in V-fashion, particularly the aircraft motor. The novel construction results in an inclined echelon or staggered arrangement of the valves extremely favorable for the cooling in which all exhaust valves are uniformly subjected to the stream of cooling air sub-divided due to this arrangement in a natural manner.

In connection with air cooled motors for motor-cars having cylinders mounted in rows it has already been proposed to use valves arranged in parallel to each other in the flat cylinder head, the axis of the valves lying in a plane inclined to the longitudinal axis of the motor, and to coordinate tilting levers having axes extending under an angle to each other.

An air cooled motor also has already been described in which in a cylinder head in the shape of a spherical segment two valves are arranged in inclined relation to each other in a transverse plane vertically to the direction of the row of cylinders.

These known constructions have serious drawbacks concerning a cooling free of objection and a high yield of output. These drawbacks are removed according to the invention in a manner free of objections.

The advantages of the free constructional arrangement of the star-connected motor cylinder regarding the thermodynamics and cooling have, according to the invention, been transferred in a manner free of objections to the arrangement of the cylinders in rows.

In the last years air cooled motors having cylinders arranged in rows have proved such surprising high outputs in flying that for certain competitions special motors have been developed whereby the designers strived to take into consideration the latest knowledge in the construction of aircraft motors and to warrant the highest possible degree of output and cooling at lowest resistance.

It is surprising in connection with these latest models of motors that the combustion spaces of the cylinders never show the form of a spherical segment in spite of the fact that the thermal superiority of this shape of combustion space surely has not been unknown to the designers. All these heavy duty type motors are fitted with a charger in connection with which valves as large as possible are desired. Nevertheless, modern air cooled motors having cylinders arranged in rows are provided with valves inclined at a small angle only, i. e. small valves. The drawbacks of such valves, i. e. high charging pressure required, high charging temperature, exhaust throttling, can under no circustances have been unknown.

If important generally known and simple requirements of the thermodynamics and the rules of flow have been disregarded, hindrances must have been present which are enumerated in the following and are to be removed by the invention. Simple considerations prove that, on account of the small distance of the cylinders from each other due to the overall length of a motor having cylinders arranged in rows, the valves may have a rather small relative inclination only, if all the valves of one row of cylinders are to be arranged one after another in a plane passing through the longitudinal axis of the crank shaft. In this arrangement want of space, therefore, forbids the spherical shape of the combustion space most favorable for obtaining best thermodynamic and cooling results.

If on the other hand, in connection with a spherical head the valve axes of the individual cylinder are arranged in a plane vertically to the crank shaft, no difficulties regarding the space but difficulties regarding the cooling result, because with this arrangement the cooling air must flow between the valve chambers of the foremost cylinder also between those of the second, third and so on as far as to the last cylinder of each row. The air flowing between the valve chambers absorbs such a large amount of heat that it would not be cool enough to warrant a sufficient cooling of the rearmost cylinders even if flowing of the air in contact with the cooling surfaces could possibly be effected. As is well

known, however, the flow of air already is ruptured after passing the first cylinder and the rear cylinders become too hot to obtain in them as high outputs as are possible by the use of a spherical combustion space.

It will therefore be seen that hitherto the valves of the individual cylinders have been arranged in parallel or under a small angle to each other only and always in the main planes of the motor, i. e. vertically or in parallel to the crank shaft and that therefore the hitherto known constructions of air cooled motors having cylinders arranged in rows represent incomplete solutions only considering the construction, the cooling and the thermodynamics.

To substantially improve motors having cylinders arranged in rows the inventor has set the problem to transfer to this construction the cylinder head known per se with a combustion space in the shape of a spherical segment and the large valve dimensions possible only with this shape of combustion space and to provide besides this the most favorable cooling ratios to thereby allow substantially increased outputs per liter of fuel which also may be used in continuous operation.

According to the present invention the arrangement of the valves corresponding to the main planes of the motor is fundamentally abandoned and the plane passing through the axes of two valves belonging together intercepts the crank shaft under a certain angle. Herewith, an inclined echelon arrangement of the individual planes is obtained and the valves may be inclined to each other under such a large angle that the combustion space may be spherically shaped.

A flowing test surprisingly clear acknowledged the supposition that by this means the cooling problem also is solved in a rather ideal manner. In contradistinction to the hitherto prevailing opinions it was found that the cooling air leaving the cooling shaft by no means branches off at right angles to the crank shaft towards the cylinders but under a certain angle which in a highly desirable manner may be made agree with the angle required for constructional reasons by the inclined echelon arrangement of the valve planes.

The invention, therefore, not only allows to transfer the cylinder construction turned out excellently well in connection with star motors upon a motor having cylinders arranged in rows, but, by the trick of the inclined echelon arrangement of the planes of the valve and by the tilting levers as well as the coordinated casings arranged at right angles to each other, it is even possible to provide equally favorable cooling airflowing ratios. This could be proved in a convincing manner by flowing tests carried out.

As mentioned already above, the invention combines the advantages of the star connected motor—usability of the spherical head with large valves and best cooling—with those of a motor having cylinders arranged in rows—low front resistance, good sight—and therefore represents a substantial improvement of the already highly developed aircraft motor with cylinders arranged in rows. The advantages obtained according to the present invention appear in particular in connection with air cooled motors having cylinders arranged in rows, but the arrangement according to the invention also has proved to be of advantage in connection with liquid cooled motors.

In the accompanying drawings the invention is shown by way of example.

In these drawings:

Fig. 1 is a perspective view of a portion of an aircraft motor having rows of cylinders arranged in accordance with the invention,

Fig. 2 is a broken away perspective top view of one of the rows of cylinders,

Fig. 3 is a broken away perspective view of a row of cylinders looking in an inclined direction,

Fig. 4 is a perspective detail top view of two juxtapositioned cylinders, and

Fig. 5 is a diagrammatic view of the arrangement of the two rows of cylinders.

In Fig. 1 an aircraft motor 1 is provided with cylinders arranged in rows 2 and 3. The cylinder heads 4 have a combustion space in the shape of a spherical segment and are provided with the valve casings 5 and 6 as well as with the corresponding gas pipe connections 7 and 8 respectively. The valves arranged in the interior of the valve casings 5 and 6 are not particularly shown. They are enclosed by means of the casings 9 and 10. In correspondence with the spherical shape of the combustion space the shafts are strongly inclined with regard to each other. A plane passing through the shafts intercepts the crank shaft not vertically but under another angle, preferably an angle between 5° and 85°.

The casings 9 and 10 surround the valve springs and the parts belonging to the tilting levers. They are arranged vertically to each other so that the lever ends against which contact the tappets are closely arranged to each other preferably in the range of the outer delimitation of the cylinder row. In this position the passages 12 for the cooling air result between the casings. If within the casing surrounding the motor the stream of cooling air is supplied between the cylinder rows, individual streams, directed obliquely towards the rear and outwardly, branch off above the cylinder heads which streams flow across the valve casings 5, 6. The cooling may further be improved by providing cooling ribs extending between the valve casings in the direction of the flow of the cooling air.

In Fig. 2 a top view of the cylinder row 2 is shown. The cylinder head in the shape of a spherical segment is designated 4. A transversely arranged tilting lever-casing is designated 10, whereas 9 designates a longitudinally directed tilting lever-casing. It will be seen that these casings are arranged about vertically to each other. Moreover, the figure shows that the planes passing through the valve axes intercept the crank shaft under an acute angle.

Fig. 3 shows a cylinder row as it appears when looking in an oblique direction. It will be seen that the end 13 of the longitudinally directed tilting lever-casing 9 and the end 14 of the transversely directed casing 10 are arranged close to each other and that the tilting levers are actuated by tappings 15, 16 which cross each other and are driven by a common cam shaft arranged outside the cylinder row. The longitudinal arrangement of the casing 9 has the advantage that the covering of the motor and also that of the body at this portion may obtain a shape very favorable from the point of view of air flowing.

Fig. 4 shows in perspective top elevation two juxtapositioned cylinders and illustrates the manner in which the relatively obliquely arranged tilting lever-casings surround a passage 12 across which the stream of cooling air, obliquely flowing

towards the cylinder head, may freely pass. The tappets in this case being arranged at the flowing off side.

Fig. 5 diagrammatically shows the two rows of cylinders, the arrangement of the valves and the subdivision of the stream of cooling air in connection with a motor having two rows of cylinders. The cylinder heads are designated **4**. The valves **18**, **19** are arranged in planes which are inclined under an angle α to the longitudinal axis of the motor. The individual streams of the cooling air indicated by their centre lines **20** flow in an inclined direction across the valve chambers. The cooling ribs between the valves of each cylinder not shown in the drawings are arranged in the direction the individual air streams have at this point.

The constructional arrangement according to the invention is of great importance in connection with air cooled aircraft gearings may, however, also be used in connection with any other motors. The invention may also be employed in connection with motors supplied with cooling air by means of a special blower.

The drawings only show examples of constructions.

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