

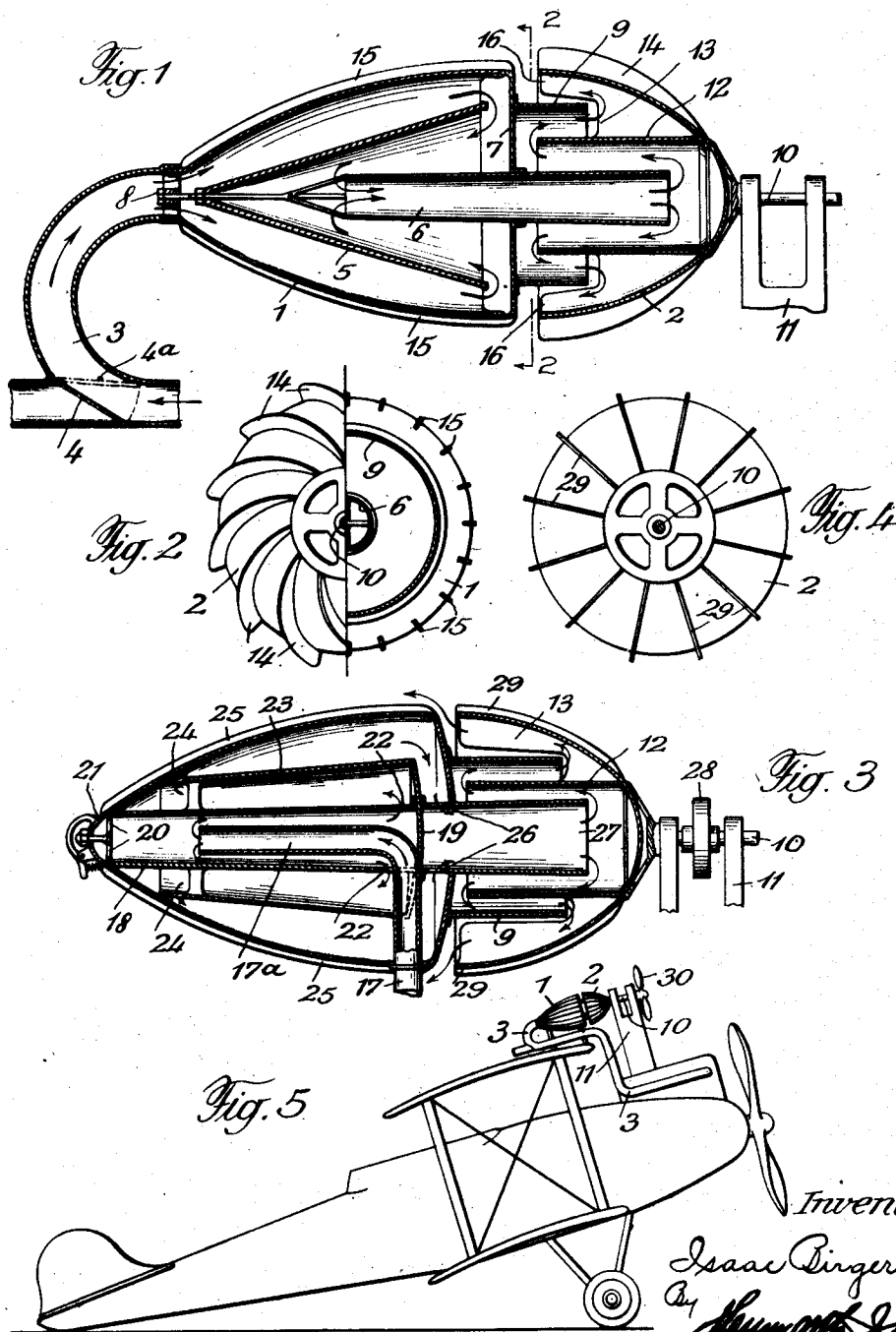
April 22, 1924.

1,490,957

I. BIRGER
METHOD AND DEVICE FOR MUFFLING THE NOISE OF THE EXHAUST
GASES OF INTERNAL COMBUSTION ENGINES

Filed July 8, 1920

2 Sheets-Sheet 1



Inventor.

Isaac Birger,

By *Henry M. Jones* atty.

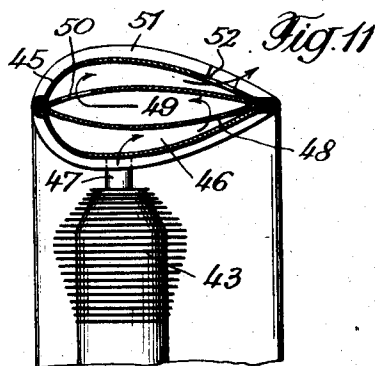
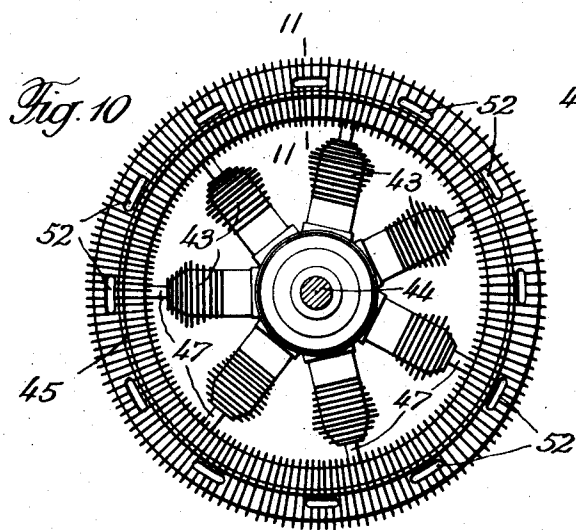
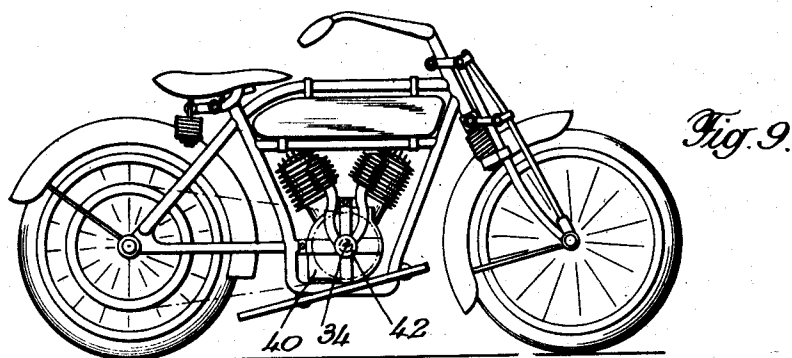
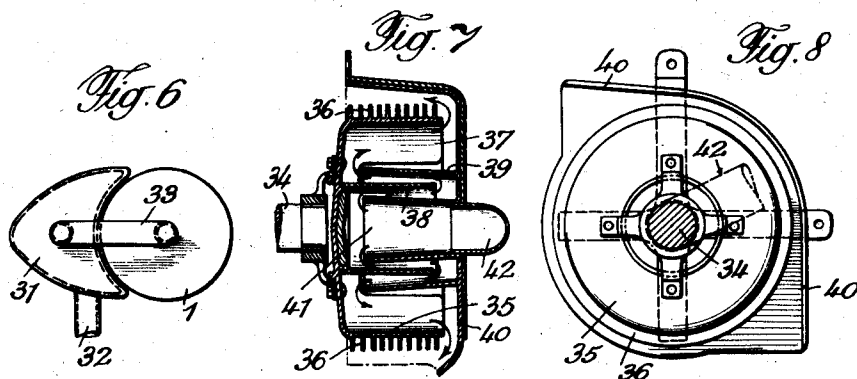
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2 Sheets-Sheet 2



Inventor:

Isaac Birger,
By *[Signature]*
Att'y.

Patented Apr. 22, 1924.

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UNITED STATES PATENT OFFICE.

ISAAC BIRGER, OF ZURICH, SWITZERLAND, ASSIGNOR TO RICHARD ERNST, OF PREGASSONA, NEAR LUGANO, SWITZERLAND.

METHOD AND DEVICE FOR MUFFLING THE NOISE OF THE EXHAUST GASES OF INTERNAL-COMBUSTION ENGINES.

Application filed July 8, 1920. Serial No. 394,692.

To all whom it may concern:

Be it known that I, ISAAC BIRGER, a citizen of the Republic of Russia, residing at Zurich, Switzerland, have invented certain new and useful Improvements in Methods and Devices for Muffling the Noise of the Exhaust Gases of Internal-Combustion Engines; and I do hereby declare the following to be a clear, full, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

The noise produced by the exhaust-gases is as a rule muffled by causing the latter to expand gradually in receptacles of large dimensions the so-called silencers whereby the exhaust-gases are forced to change their direction of flow repeatedly for the purpose of depriving them of their energy.

The present invention shows the new feature that the cooling of the exhaust-gases is caused to assist in muffling the noise. This is done, whilst maintaining the principle of the change of direction of flow, by causing the exhaust-gases by centrifugal force to get during their flow into contact with metal walls whereby the cooling effect is increased and the concentration of the gases resulting thereof assists in removing the burnt gases out of the receptacle. Thereby the hitherto existing drawbacks such as the large size and weight of the silencer receptacle, resistances to the exhaust and overheating of the cylinder walls are overcome. A device according to the invention shows the feature that to a part of the silencer or to the whole silencer a rotary motion is imparted. Corresponding to the variety of the constructions of internal combustion engines the silencers according to this invention may be of various shapes. In engines where the arrangement of the different parts of the engine permits it, rotating parts of the engine for instance the fly-wheel, may be constructed so as to act as silencers. In most cases, however, the silencers are constructed as separate parts of the engine. The driving force for imparting rotation to the muffling device may be derived from the engine shaft or it may be independent thereof, for in-

stance with motor driven vehicles the rotation may be obtained by the induced air current.

Several exemplifications of the invention are shown on the accompanying drawings, on which:

Fig. 1 illustrates a longitudinal section through a first exemplification;

Fig. 2 is partly a front view and partly a section along line 2—2 of Fig. 1;

Fig. 3 is a longitudinal section through a second exemplification;

Fig. 4 is a front view of Fig. 3.

Fig. 5 shows a third exemplification fitted to a flying machine.

Fig. 6 is a side view showing a fourth example of the invention;

Fig. 7 illustrates a fifth exemplification in longitudinal section;

Fig. 8 is a front view of Fig. 7;

Fig. 9 shows the device shown in Figs. 7 and 8 fitted to a motor cycle;

Fig. 10 is a side view of a sixth exemplification;

Fig. 11 is a section along line 11—11 of Fig. 10 on a larger scale.

In the exemplification shown in Figs. 1 and 2, 1 denotes a fixed part and 2 a rotating part. 3 is the conduit for the burnt gases in which a bye-pass valve 4 is provided which can be brought into the position 4^a shown in dotted lines whereby the silencer is cut out and the gases exhaust directly into the atmosphere. The part 1 is cup-shaped, a funnel 5 is co-axially fixed inside it. The latter is rigidly fixed to a pipe 6 on which a cover plate 7 is mounted and which is pressed by means of a nut 8 against the cup 1. A pipe part 9 is secured to the cover plate 7 and projects into the part 2 of the silencer. The part 2 forms as it were the cover of the cup 9, but it does not fit tightly onto it. The part 2 is provided with a shaft 10 mounted in bearings 11. A cylindrical part 12 which is open towards cup 1 and into which pipe 6 projects, is fixed to part 2. Between the outer surface of the cylindrical pipe 12 and the inner surface of part 2 stiffening blades 13 are arranged which are shaped such as to clear the projecting pipe 9. The outer surface of part 2 is fitted with helical blades 14 and to the outer surface of part 1 straight cooling ribs 15 are provided.

The whole muffling device is of an ovoid shape that is very favourable with regard to the air resistance.

The exhaust gases which flow in the direction of the arrows shown in Fig. 1 enter by means of conduit 3 the cup 1, in which part they are already subjected to an expansion and to a cooling effect, from there they reach the funnel 5 by changing their direction of flow. By a further change of direction they enter the pipe 6 and from there pass into the part 2 to which rotation is imparted by the action of the current of air induced by the travelling motion on the blades 14. Inside the part 2 the gases flow at first by performing a change of direction in close contact along the cylinder 12 and enter the pipe 9 and then after another change of direction get between the rotating blades 13 by which they are pushed against the cool inner surface of part 2 by the centrifugal action, whereupon they are driven out through the slots 16. At these slots 16 the burned gases are subjected to a further suction action by the action of the passing air-current. By the action of the centrifugal forces the exhaust gases are forced to flow inside the rotating part in close contact with the cool metal walls which feature enhances the cooling effect and thereby the muffling action and on the other hand causes a decrease of the exhaust resistance in consequence of the contraction and a thereby resulting further increase of the suction action on the exhaust gases. In the constructional example shown in Figs. 3 and 4 the exhaust-gases are admitted into part 1 by means of a pipe 17. The end 17^a of that pipe is bent in the direction of the axis of part 1 and projects into a cylinder 18 which is closed at 19 and which is provided with ports 20 which open towards a valve 21 that can be operated from outside in order to cut out the silencer and to work with direct exhaust into the atmosphere, this valve serves at the same time as relief-valve. When the valve 21 is closed the gases flow towards the cover 19 in the direction of the arrows shown and from there through ports 22 into an outer cylinder 23 then changing again their direction and flowing through ports 24 towards the inside of the wall of part 1, which wall is provided at its outer surface with cooling ribs 25. Then the gases pass ports 26 provided in a pipe 27 which is rigidly connected to part 1 and projects into the rotating part 2. The latter is, similar to that illustrated in Fig. 1, provided with a cylindrical pipe 12 and is fitted with stiffening ribs 13 which act at the same time as blades. A pipe 9 is arranged at part 2 and extends towards the blades 13 so that the passage of the gases inside part 2 and the action of the rotation of this part on the

gases is the same as that described for the constructional example shown in Fig. 1. To the axle 10 which is mounted in bearings 11 rotation is imparted by means of a pulley 28 and a belt which is not shown in the drawings. The part 2 is provided on its outside with radial cooling ribs 29 as is shown in Fig. 4. The exemplification shown in Fig. 5 is essentially the same as that illustrated in Fig. 3, the only difference being that the admission pipe 3 for the exhaust-gases is connected to the rear of part 1, as is shown in detail in Fig. 1, and that the driving shaft 10 for part 2 which shaft is mounted in bearings 11 is driven by a propeller 30 when the flying machine is traveling.

An arrangement adapted to give to the cylindrical part 1 in the direction of running the egg-shape which is favourable with regard to the air-resistance is shown in Fig. 6 and consists in providing a suitably shaped receptacle 31 laterally of part 1, to which the exhaust pipe 32 is connected. The receptacle 31 assists in muffling the noise of the exhaust in a known manner.

The exemplification illustrated in Figs. 7 and 8, which, is as shown in Fig. 9, is specially suited for being fitted to motorcycles, comprises a cup-shaped part 35 which is rigidly connected to motor shaft 34 and rotates with the latter. The outer face of the cup 35, which is slightly widened towards its open end, is fitted with cooling ribs 36. The inner side is provided with blades 37 and with a cylindrical member 38. A cylindrical pipe 39 penetrates into the interior of the cup and is secured to a fixed casing 40 which also widens out towards its open end. A conical branch pipe 41 projects into the cylindrical member 38, the exhaust gases are supplied to pipe 41 by a pipe 42. The arrows shown in Fig. 7 denote the path of the exhaust gases and all the changes in the direction of the flow by which the gases are caused to pass through the various chambers formed by the parts inserted into each other the size of these chambers increasing continuously whereby the cooling and muffling action is increased. The silencing device can also be arranged so that the rotating part 35 acts at the same time as fly-wheel of the cycle engine by increasing the weight of part 35.

The example for carrying out the invention shown in Figs. 10 and 11 represents a silencer applied to a rotating combustion engine, 43 denotes the cylinders rotating around the axis 44. An angular silencer 45 is arranged around the cylinder spider. Fig. 11 illustrates a radial section of the silencer which is again of an ovoid shape. A chamber 46 is connected by means of branch pipes 47 with all the cylinders through which pipes the exhaust gases are conducted to chamber 46. The gases enter chambers 49

through openings 48 and from there through ports 50 into chambers 51 from where they escape into the atmosphere through slots 52. The various ports are again arranged such that the gases are caused to change their direction of flow repeatedly on flowing through the device.

The deposit of soot at the walls of the silencers is with all the exemplifications shown very unimportant as the greatest part of the soot is thrown out and a good conductivity of heat of the walls is maintained.

I claim:

1. A method for muffling the noise of the exhaust gases of internal combustion engines, comprising causing the exhaust gases by the action of the centrifugal force to flow in close contact with rotating and relatively cool walls for the purpose of cooling the gases, and using the contracted gases resulting from the cooling action to generate a suction action on the exhaust gases supplied.

2. A device for muffling the noise of the exhaust gases of internal combustion engines, comprising a fixed member, a rotating member, and means to cause the exhaust gases to flow in close contact with the walls of said fixed and rotating members and to change the direction of the flow repeatedly.

3. A device for muffling the noise of the exhaust gases of internal combustion engines, comprising a stationary member, a rotatably mounted member partly inclosing said stationary member, means fitted to said rotatably mounted member to impart rotation to it, and means to cause the exhaust gases to flow in close contact with the walls of said stationary and rotating members and to change the direction of flow repeatedly.

4. A device for muffling the noise of the exhaust gases of internal combustion engines, comprising a fixed member, a rotating

member, means to cause the exhaust gases to flow in close contact with the walls of said fixed and rotating members and to change the direction of the flow repeatedly, and cooling ribs fitted to the outside of said fixed and rotating members.

5. A device for muffling the noise of the exhaust gases of internal combustion engines, comprising a fixed member, a rotating member, said two members being arranged co-axially at such a distance from each other and shaped such that a longitudinal section through both is of an ovoid shape, and means to cause the exhaust gases to flow in a close contact with the walls of said fixed and rotating members and to change the direction of flow repeatedly.

6. A device for muffling sound, comprising a fixed member, a rotating member and means to cause the exhaust gases to flow in close contact with the walls of said fixed and rotating members and to change the direction of flow repeatedly, which means include blades fitted to the interior of the rotating part.

7. A device for muffling the noise of the exhaust gases of internal combustion engines, comprising a fixed member, a rotating member arranged co-axially to the fixed member, cup shaped members fixed to said fixed and rotating member inserted into each other and dimensioned such that the cubic content of the chambers formed by every two cup shaped members increases continuously from the entrance of the gases to their exit, and means to cause the exhaust gases to flow in close contact with the walls of said fixed and rotating members and to change the direction of flow repeatedly.

In testimony that I claim the foregoing as my invention, I have signed my name.

ISAAC BIRGER.