

June 2, 1959

A. BÜCHI
AIR BYPASS OR SURGE CONTROL FOR SUPERCHARGED
INTERNAL COMBUSTION ENGINES

2,888,799

Original Filed March 5, 1947

2 Sheets-Sheet 1

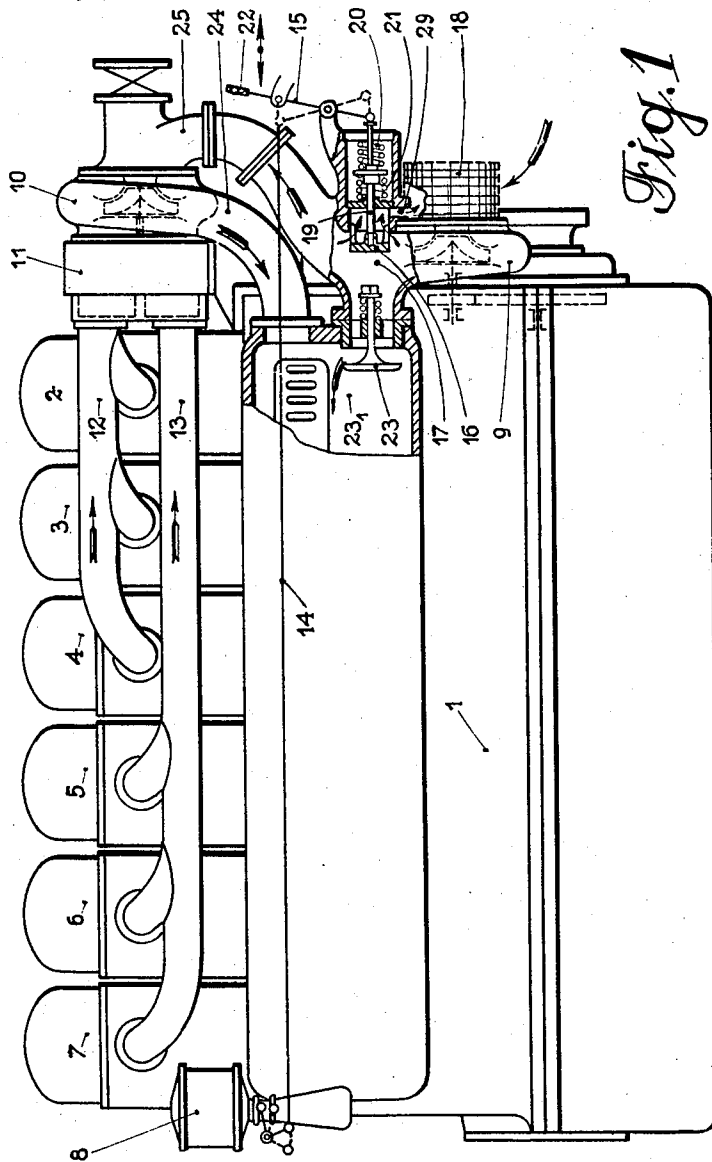


Fig. 1

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Fig. 2

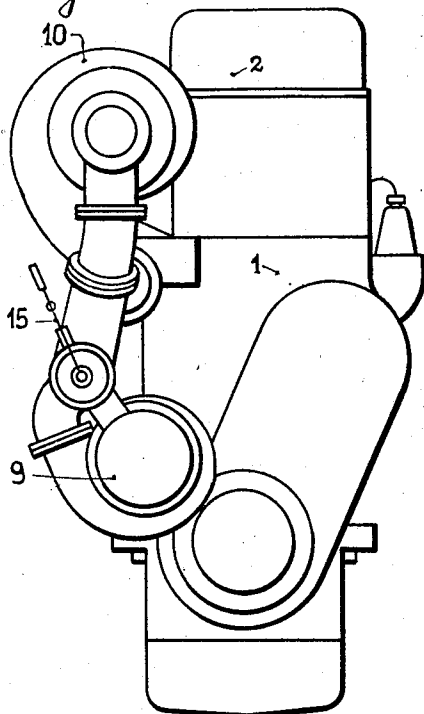
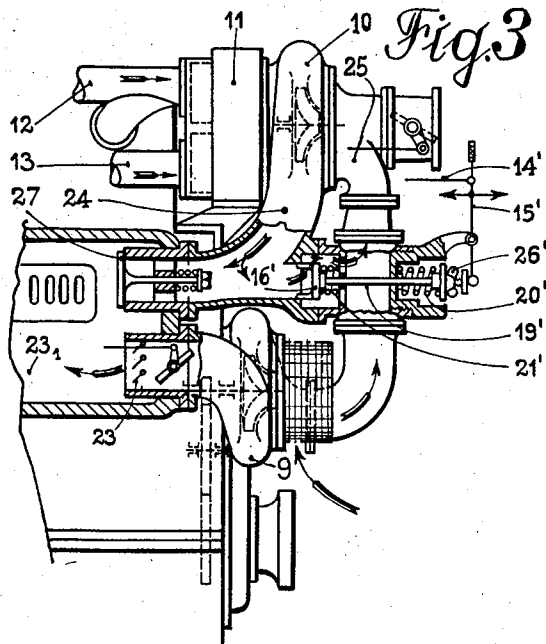


Fig. 4

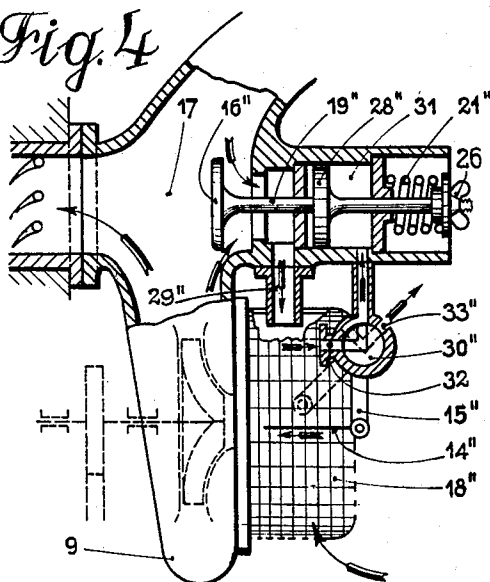
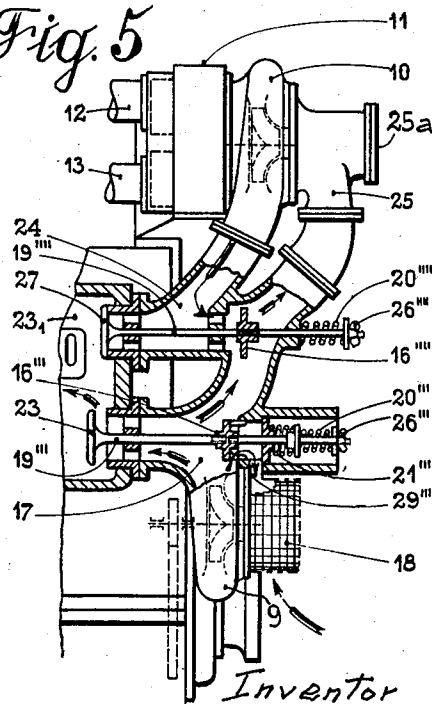


Fig. 5



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AIR BYPASS OR SURGE CONTROL FOR SUPERCHARGED INTERNAL COMBUSTION ENGINES

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Application May 19, 1950, Serial No. 170,722, now Patent No. 2,684,569, dated July 27, 1954, which is a division of application Serial No. 732,640, March 5, 1947, now Patent No. 2,636,341, dated April 28, 1953. Divided and this application May 27, 1954, Serial No. 433,874

Claims priority, application Switzerland March 12, 1946

3 Claims. (Cl. 60—13)

My present invention relates to improvements in surge-preventing arrangements on supercharged internal combustion engines comprising a plurality of charging blowers, of the centrifugal and/or axial type, at least one thereof being driven by the engine exhaust gases. Such engines are of the type in which the charging blowers—in accordance with the state of operation of the engine—are cut in or out relative to the air supply, so that at least one thereof delivers directly into the engine. This application is a division of my copending Serial No. 170,722, filed May 19, 1950, now Patent No. 2,684,569, issued July 27, 1954, as a division of Serial No. 732,640, filed March 5, 1947, now Patent No. 2,636,341, issued April 28, 1953.

The subject matter of my present invention consists in control gears, riggings or arrangements adapted to prevent—at any given piping connection of the blower delivery lines with the engine—the occurrence of irregularities (such as “hard swallowing,” surging or squalling) in the delivery of at least one of the charging blowers. Such controls, which e.g. may comprise devices for blowing off part of the pressure fluid (delivered by the respective blower) into a space of lower pressure or other devices serving for the same purpose, may be adjusted either directly by means of the engine governor or by means of the pressure of a pressure fluid supplied by the engine, such as the exhaust gases, the charging air or the lubricating oil and the like. Such controls also, however, may be operated in common in engines comprising elements (adjustable automatically or from the outside) for piping the output from different kinds of charging blowers directly to the engine or to the other kind of blower.

In the explanation which follows, I assume that the reader is familiar with charging devices for internal combustion engines such as are the subject of my Patent No. 2,296,268, issued September 22, 1942.

Several forms of invention are shown, by way of example, in the accompanying drawings, in which:

Figs. 1 and 1a show a side elevation of a motor, partly in section through a control rigging,

Fig. 2 is a front view of the motor of Fig. 1, and

Figs. 3, 4 and 5 illustrate other forms in partial sections and partly in elevation.

The internal combustion engine 1 in Figs. 1 and 2 possesses six cylinders 2-7, a governor 8, and two charging blowers 9 and 10. Blower 9 may be of the radial or axial type, and driven by the engine or independently thereof. Blower 10 also may be of the radial or axial type, and is driven by the exhaust turbine 11 which is fed through the exhaust manifolds 12 and 13.

The control rigging according to my present invention, now, is so adapted that—when blower 9, with bypass-valve 16 closed, otherwise would “swallow hard” or be subjected to surges or squalls—governor 8, by way of the rigging 14, 15, opens the circular valve 16, thus opening

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the delivery space 17 of blower 9 to the air-intake structure 18 by way of duct 29. Blower 9 is swallowing hard or surging, e.g., when it is of relatively large capacity, and when the exhaust-turbine driven blower 10 were sucking no or only little air. Such latter case, again, may arise upon starting the engine or at low load and/or low speed, in spite of valve 23 being open. The entrance chamber for the charging air to engine 1 is designated by 23₁.

Lever 15 may be connected to valve rod 19, either fastly or (as shown in Fig. 1) loosely, so that the latter is actuated by rod 14 only for opening valve 16, in that, when governor 8—with engine 1 idling—is raised, rod 14 is pushed to the right. Governor 8, therefore, is not instrumental in closing valve 16. When governor rod 14—with the load on engine 1 increasing—moves to the left valve 16 automatically is closed again by the spring 21, acting against the spring 20.

A handle 22 may be provided on lever 15 to permit, when required, of holding open or closing circular valve 16 independently of governor 8.

In the form of invention according to Fig. 3, a circular valve 16' is so built into the delivery line 24 of the exhaust-turbine driven blower 10 as to permit of establishing communication between delivery line 24 and suction line 25 of blower 10. Valve 16' here again (as in Fig. 1) is actuated by governor 8 by way of rigging 14', 15', and comprises a guide stem 19', a helical spring 21' tending to push valve 16' to the left into closing position, and a helical spring 20' tending to push valve 16' to the right into open position. Spring disc 26' is adjustably mounted on stem 19' to permit of adjusting the tension of springs 20' and 21'.

Valve 16' is opened—in accordance with my present invention—when, as seen from Fig. 3, delivery line 24 of blower 10 to entrance chamber 23₁ is closed yet by the valve 27, as shown, but engine 1 and thus also exhaust turboblower 10/11, having been started already, is not cable yet of building up sufficient pressure to open valve 27. If bypass valve 16' were not opened at this stage of operation, blower 10 would “swallow hard” i.e. be subjected to surges, which condition shall be prevented by means of my present invention.

Fig. 4 shows a form of invention, wherein the by-pass valve 16'' is actuated by means of a piston 28'' secured to valve stem 19''. Piston 28'' is pushed to the left, biased by a pressure fluid (charging air, exhaust gases, lubricating oil and the like). Valve 16'' thus is opened and at least part of the air in delivery space 17 may escape through duct 29'' into air-intake 18'' of blower 9. A wing nut 26'' is mounted on the outer end of stem 19'', and is pushed by a spring 21'' to the right, i.e. said spring tends to close valve 16''.

The pressure fluid is supplied through the circular valve 30'' into the cylindrical space 31. In Fig. 4, valve 30'' is shown in a position in which the pressure fluid is permitted of flowing from 32 into space 31, and which corresponds to the position of lever 15'' shown in full lines. Lever 15'' is set, e.g., by a governor (not shown) by means of the rod 14''.

In the position of lever 15'' shown by dotted lines, the admission of pressure fluid at 32 is closed, and cylinder space 31 is drained through the aperture 33''. The pressure of spring 21'' then closes valve 16''. The latter is opened again in the same way as described in connection with Fig. 1.

Fig. 5 shows a form of invention, wherein the valves 16''' and 16'''' are directly connected with valves 23 and 27 respectively. The latter close independently of each other, in that they are automatically opened or closed when a higher pressure exists in the engine entrance-

chamber 23, than blowers 9 and 10 respectively are capable of building up in their state of operation. The arrangement, further, may be such that valve 16''' is opened when valve 23 also is opened. Valves 16''' and 23 also may close approximately at the same time. Such may be the case, when the engine is started, or when it is running under low load.

Valve 27, however, is closed, when valve 16''' is open, so that the air then is bypassed from the delivery chamber 24 into the suction chamber 25 of the same blower 10. Valves 23, 16''' and 27, 16''', respectively, are biased into certain desired positions by the springs 20'', 21''' and 20''' respectively. The wing nuts 26''' and 26'''' permit of adjusting the spring actions. As indicated at elements 16''' and 16''', the spacing of the latter from valves 23 and 27 (which are disposed on the same spindle or stem respectively) also may be made adjustable.

Arrangements according to Figure 5 are capable of operating altogether automatically at all operating stages of engine 1. They cut the delivery lines of the blowers in and out properly, and at the same time prevent the occurrence of the phenomenon of "swallowing hard," surging or squalling in the kinds of charging blowers used.

Wherever the term "independently driven" is employed to describe "blower" or "blowers" in the claims, I intend to comprehend a blower or blowers which are not driven by an exhaust gas turbine, but rather, by gearing with the engine shaft, or by some other powered rotating unit, such as an electric motor.

What I claim and desire to secure by Letters Patent is:

1. In a supercharged internal combustion engine provided with at least one turboblower driven by the exhaust gases of the engine and an auxiliary independently driven blower, an exhaust conduit to connect the turbo-blower and exhaust outlet of the engine, both of which blowers supply air under pressure to the air intake chamber of the engine, said chamber being provided with valve means operable by the discharge pressure of the auxiliary blower against the fluid pressure in said chamber to direct thereby the air from the auxiliary blower either directly or through the turboblower into said chamber, a by-passing valve, an engine speed responsive device, and linkage connecting the said device with said by-passing valve for operation in response to engine speed, said by-passing valve controlling a passage between the pressure side and the suction side of the auxiliary blower to permit in the open condition of said by-pass valve means for the escape of a sufficient quantity of pressure air through said passage to prevent surging of the auxiliary blower when it is in direct connection with said engine air intake chamber.

2. In a supercharged internal combustion engine provided with at least one turboblower driven by the exhaust gases of the engine and an auxiliary independently driven blower, an exhaust conduit to connect the turbo-blower and exhaust outlet of the engine, both of which blowers supply air under pressure to the air intake chamber of the engine, said chamber being provided with valve means operable by the discharge pressure of the auxiliary blower against the fluid pressure in said chamber to direct thereby the air from the auxiliary blower either directly or through the turboblower into said chamber, a by-passing valve, an engine speed responsive device, and linkage connecting the said device with said by-passing valve for operation in response to engine speed, said by-passing valve controlling a passage between the pressure side and the suction side of the auxiliary blower to permit in the open condition of said by-pass valve means for the escape of a sufficient quantity of pressure air through said passage to prevent surging of the auxiliary blower when it is in direct connection with said engine air intake chamber, and a spring mechanism to return said by-passing valve to closed position when said speed responsive device ceases to actuate said linkage holding open said bypassing valve.

3. In a supercharged internal combustion engine comprising a first blower driven by an exhaust gas turbine of the engine, said blower discharging into an air chamber for charging the engine, an exhaust conduit to connect the turbo-blower to the engine, a second blower driven by shaft means of the engine and directly connected to said air inlet chamber and comprising conduit means to discharge to the entrance of said turbo-blower, a valve under spring pressure between said chamber and the pressure side of said second blower, said valve being maintained closed by said spring pressure and by fluid pressure discharged from said first blower, a by-passing valve between the pressure side of the second blower and the suction side thereof, a device responsive to the speed of the engine, and means connecting the said device with said by-passing valve, said means being constructed and disposed to provide for an open period of said by-passing valve at low speed of the engine coinciding with low pressure condition in said chamber, whereby the discharge pressure of the second blower opens, said valve between said chamber and the pressure side of said second blower to prevent surging thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

2,296,268	Büchi	Sept. 22, 1942
2,404,324	Staley	July 16, 1946
2,636,341	Büchi	Apr. 28, 1953
2,684,569	Büchi	July 27, 1954