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Morrall

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[54] **MEANS FOR PURIFYING THE EXHAUST DISCHARGE OF INTERNAL COMBUSTION ENGINES**

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[52] **U.S. Cl.** ..... **23/277 C;** 60/303

[51] **Int. Cl.²** **F01N 3/10;** F23G 7/06

[58] **Field of Search** ..... 23/277 C, 288 F, 288 FC; 60/303

[56] **References Cited**

UNITED STATES PATENTS

2,038,567	4/1936	Ittner	60/303 X
2,203,554	6/1940	Uhri, Jr. et al	23/277 C
2,649,685	8/1953	Cohen	23/277 C
2,831,548	4/1958	Barkelew	60/303 X
2,956,865	10/1960	Williams	60/303 X
3,065,595	11/1962	Gary	60/303 X
3,170,280	2/1965	Rees	60/303
3,435,613	4/1969	Eannarino et al	23/277 C
3,460,916	8/1969	Aronsohn	23/277 C X
3,683,625	8/1972	McCrink	60/303 X
3,706,533	12/1972	Brewer	23/288 F X

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Assistant Examiner—Arnold Turk
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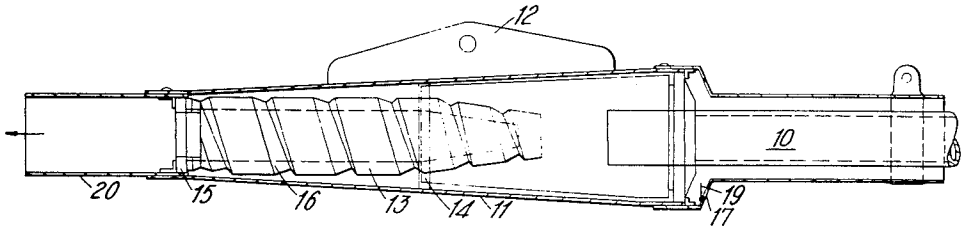
[57] **ABSTRACT**

A device for purifying the exhaust discharge of an internal combustion engine including a housing in which is a heat retaining member formed from unglazed, porous ceramic material and arranged such that the exhaust gases pass both over its outer surface in a space between the heat retaining member and the inner wall of the housing and through the porous ceramic member, the heat retaining member having an end portion of tapering cross-section with its narrow end which is closed directed towards the incoming exhaust stream, and means being provided for admitting air to the housing before the exhaust stream comes into contact with the heat retaining member.

8 Claims, 9 Drawing Figures



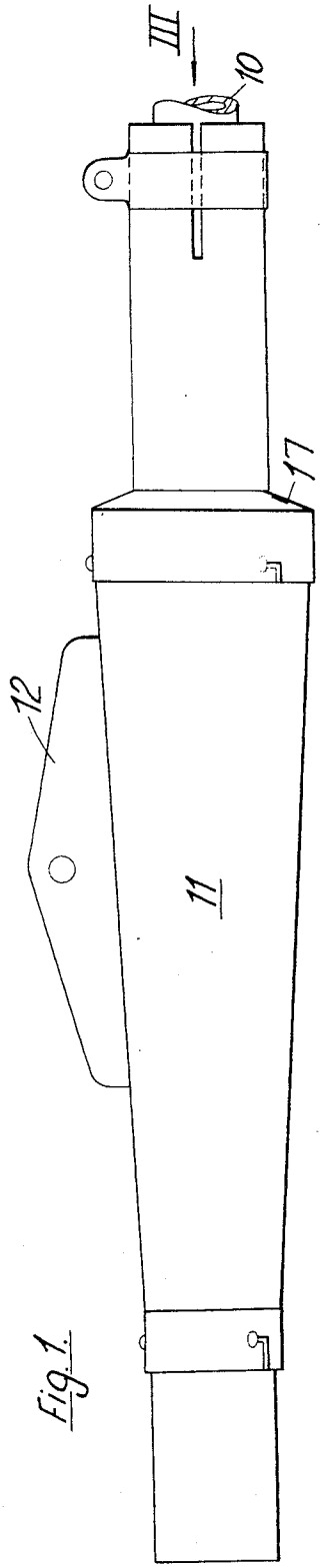


Fig. 1.

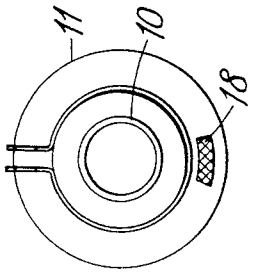


Fig. 3.

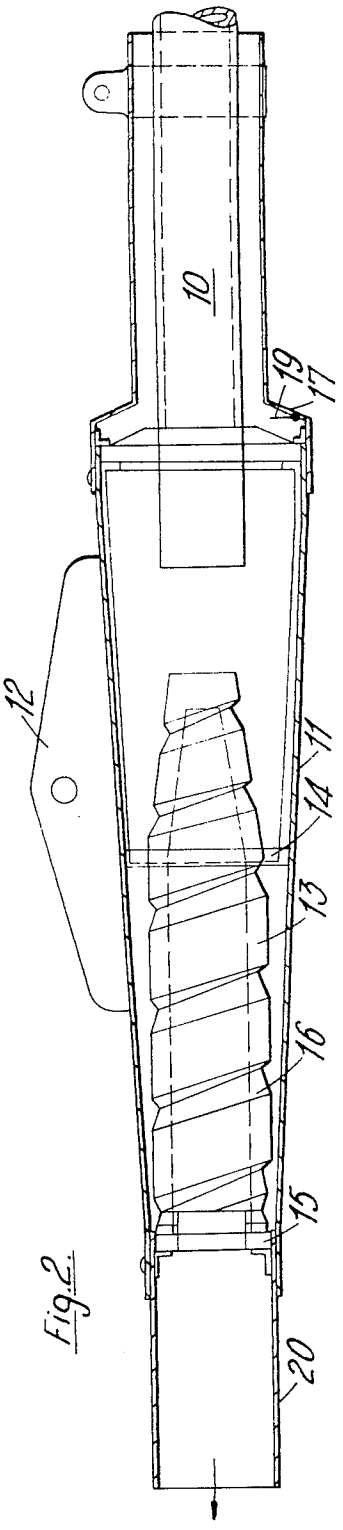


Fig. 2.

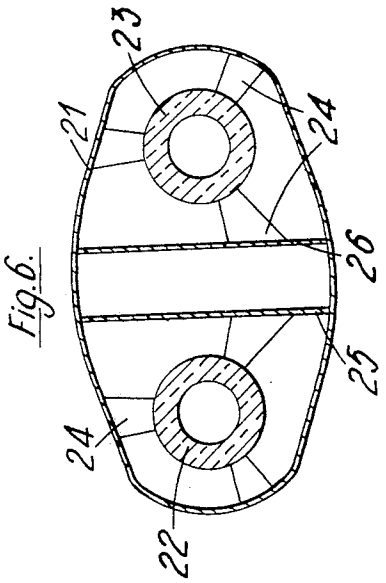


Fig.6.

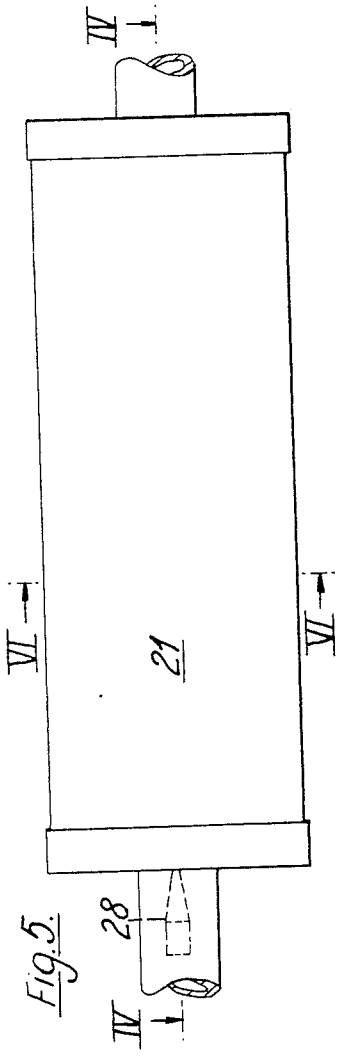


Fig.5.

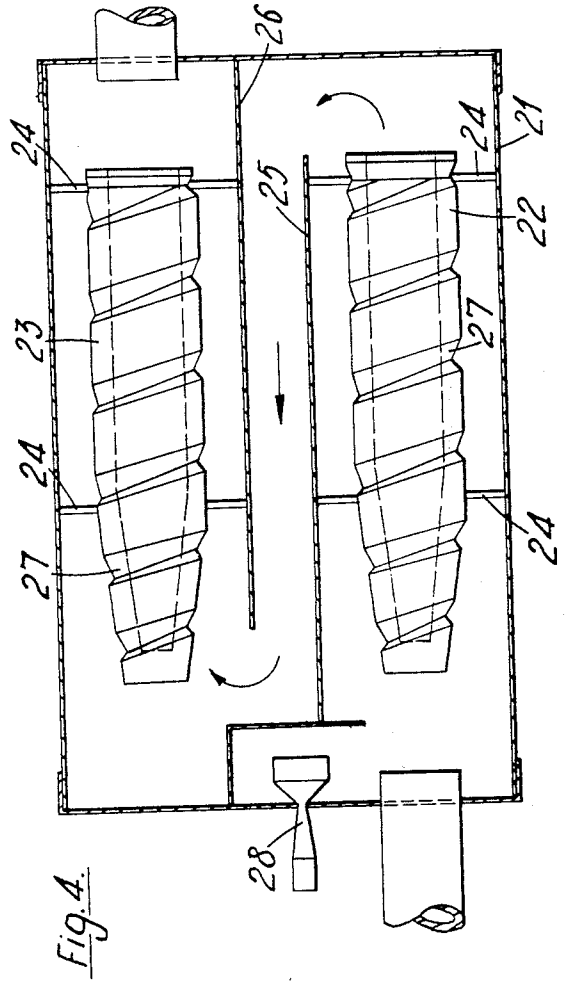


Fig.4.

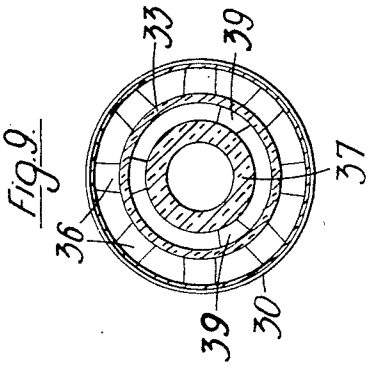


Fig. 9.

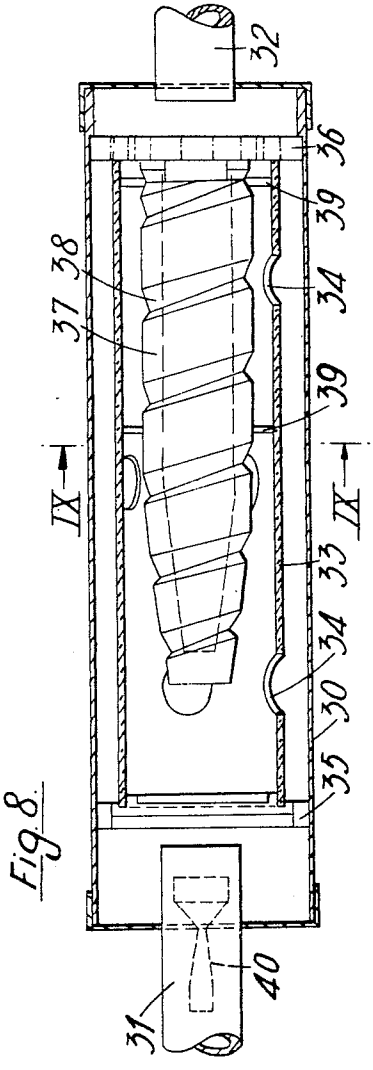


Fig. 8.

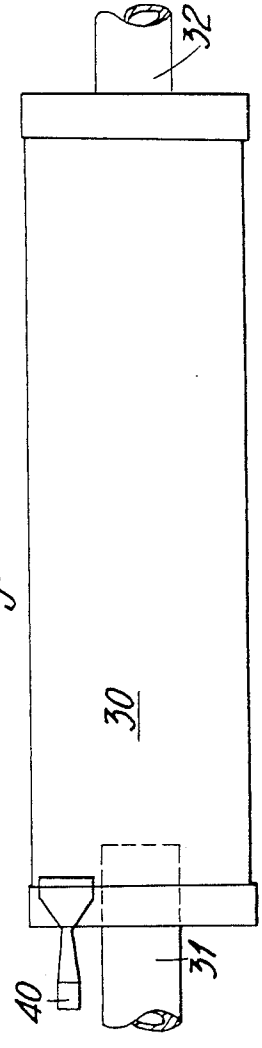


Fig. 7.

MEANS FOR PURIFYING THE EXHAUST DISCHARGE OF INTERNAL COMBUSTION ENGINES

The invention relates to means for purifying the exhaust discharge of internal combustion engines.

The invention provides a device for purifying the exhaust discharge of an internal combustion engine, the device including a housing having located therein a heat-retaining member formed from unglazed porous ceramic material and arranged such that the exhaust gases pass over its outer surface in a space between the latter and the inner wall of the housing, the heat-retaining member having an end portion of tapering cross-section with its narrow end directed towards the incoming exhaust stream, and there being means for admitting air to the housing before the exhaust stream comes into contact with the heat-retaining member.

Preferably the heat-retaining member has a helical channel in its outer surface serving to guide the gases round the surface and thereby increase the length of their path of contact with the member and the period of contact.

The device may be located in any position in the engine exhaust system or in a position close to but slightly spaced from the tail pipe. Preferably however the device is located as close as possible to the engine in order that the heat-retaining member may be maintained at a high temperature.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of one form of device incorporated in the tailpiece of a motor vehicle exhaust system;

FIG. 2 is a vertical cross-section through the device shown in FIG. 1;

FIG. 3 is a view in the direction of arrow III in FIG. 1;

FIG. 4 is a section on the line IV — IV in FIG. 5;

FIG. 5 is a side elevation of a modified device incorporating two heat retaining members in series;

FIG. 6 is a section on the line VI — VI in FIG. 5;

FIG. 7 is a side elevation of a further form of device;

FIG. 8 is a vertical cross-section through the device shown in FIG. 7; and

FIG. 9 is a section on the line IX — IX in FIG. 8.

Referring to FIGS. 1 to 3 the device comprises a unit adapted to be fitted to the tail pipe **10** of the vehicle exhaust system, the unit having a metal housing **11** provided with brackets **12** enabling it to be attached to a suitable part of the vehicle. Within the housing **11** a tapered hollow heat retaining member **13** formed from unglazed porous ceramic material is supported in front and rear by support brackets **14** and **15** respectively, with the small diameter end of the member being closed and directed towards the tail pipe **10.** A spiral groove or channel **16** is formed in the member **13** and serves to form a tortuous path around which exhaust gases travel in contact with the surface of the member in their travel through the device. An air inlet opening **17** is provided adjacent the forward end of the housing **11.** This opening allows entry of clean air into the housing for mixture with the exhaust stream before the latter impinges on the heat retaining member **13.** The inlet **17** is closed by a perforated gauze **18** (FIG. 3) and a baffle plate **19** (FIG. 2) serves to prevent escape of exhaust gases to atmosphere. This will not occur during normal running of the engine but could take place under idling conditions. The exhaust products are finally discharged to the atmosphere through an outlet pipe **20.**

The arrangement of FIGS. **1** to **3** may be readily fitted in position on the rear of the existing exhaust system. However since it is a considerable distance away from the engine the heat retaining member does not receive and absorb a great amount of heat and this form of device also tends to produce a certain amount of back pressure. FIGS. **4** to **6** illustrate an alternative arrangement which may be fitted to the exhaust system in a position nearer to the engine. The unit includes a casing **21** within which two heat retaining members **22,** 23 are mounted in suitable supports **24.** Internal baffles **25** and **26** are provided and direct the exhaust stream over the two heat retaining members in turn. The heat retaining members are closed at their narrow ends and are provided with spiral channels **27** similar to those described with reference to FIGS. **1** to **3** and these channels together with the baffles **25** and **26** form a path of considerable length around and along which the exhaust gases travel. The gases are therefore maintained in contact with the heat retaining members for a considerable period of time. A venturi device **28** is provided adjacent the inlet to the unit and serves to permit clean air to be drawn into the unit while preventing escape of exhaust gases. Since this unit is located closer to the engine a considerable amount of heat will be transmitted to and absorbed by the two heat retaining members and this increases the efficiency of purification of the exhaust gases compared with the arrangement of FIGS. **1** to **3.**

FIGS. **7** to **9** illustrate a further modification which may be fitted at the manifold end of the exhaust pipe or at the rear of a unit such as that described with reference to FIGS. **4** to **6.** The arrangement shown in FIGS. **7** to **9** includes an outer cylindrical metal casing **30** with which inlet and outlet pipes **31** and **32** communicate. Within the casing **30** a tubular ceramic or refractory sleeve **33** provided with a series of perforations **34** is supported in end pieces **35** and **36.** A heat retaining member **37** closed at its narrow end and having a spiral channel **38** formed in its outer surface is supported by suitable supports **39.** A venturi device **40** is provided at the inlet end of the casing to permit entry of clean air while preventing escape of exhaust gases.

The precise manner in which the devices described above function to purify exhaust gases is not fully understood but is believed to be as follows. The heat retaining member receives heat from the hot exhaust gases and retains this heat thereby raising the temperature within the device well above that which would be attained by mere passage of the gases through the housing. The provision of the spiral channel in the heat retaining member forms an extended path along which the exhaust gases pass in contact with the high temperature outer surface of the heat retaining member. In the case of the arrangement described with reference to FIGS. **4** to **6** the path is considerably increased due to the provision of two heat retaining members in series.

The introduction of clean air then creates the situation that solid particles of carbon and other impurities together with incompletely burnt gases are subjected to a sufficient temperature for a sufficient period of time in an atmosphere containing sufficient oxygen to pro-

mote further combustion. Carbon, hydrocarbons, lead acids and hydrogen are thereby burnt and carbon monoxide oxidised to carbon dioxide, this carbon dioxide being discharged to atmosphere and the residue of the burnt constituents being deposited on the heat retaining member. The efficiency of the process has been found to increase with increase in temperature of the heat retaining member so that those arrangements positioned closest to the engine have the greatest efficiency.

A further advantage of devices according to the invention is that they are self cleaning. At vehicle speeds above about 45 miles per hour the extent of pollution of the exhaust gas stream is much less than at lower speeds. At these higher speeds the residue deposited on the heat retaining member will be dried and crystallized, the crystals will be removed by the outgoing exhaust stream, and in this way the heat retaining member is restored to its original condition. If fitted to vehicles designed only for very low speeds the devices could of course be constructed in a manner enabling removal of the heat retaining members periodically for cleaning treatment.

It should be noted that the inner ceramic sleeve **33** of the arrangement shown in FIGS. **7** to **9** serves to concentrate more heat on to the heat retaining member thereby increasing its efficiency.

Various modifications may be made without departing from the scope of the invention as defined in the appendent claims. For example, the heat retaining member or members could be arranged such that the exhaust gas stream passes through each member as well as over it. The relative dimensions of the heat retaining member and housing may be altered as desired and any convenient number of heat retaining members may be arranged in series or in parallel to increase the length of the contact path and the period of contact. Alternatively a number of devices such as those illustrated could be used in combination, and the invention is of course applicable to engines other than motor vehicle engines.

I claim:

1. A device for purifying the exhaust discharge of an internal combustion engine, the device including a housing having an inlet and an outlet, a hollow heat-retaining member located within the housing and occupying a substantial part of the housing, said member being formed from unglazed porous ceramic material and arranged such that the exhaust gases may pass over its outer surface in a space between the latter and the inner wall of the housing and through the porous material to the hollow interior, the heat-retaining member having an end portion of tapering cross-section with its narrow end closed and directed towards the incoming exhaust stream and a helical channel in the outer surface of the member serving to guide the gases around the surface and thereby increase the length of their path of contact with the member, the heat generated within the device being derived solely from the exhaust gases, and means for admitting air into the exhaust stream upstream of the heat-retaining member.

2. A device according to claim **1** wherein said means for admitting air includes means to prevent escape of exhaust products through the air inlet.

3. A device according to claim **1** including a plurality of heat-retaining members arranged in series.

4. A device according to claim **3** wherein said heat retaining members are arranged side-by-side and baffle means is provided to direct the exhaust stream over the members in turn.

5. A device according to claim **1** wherein the heat-retaining member is surrounded by a sleeve member of heat-retaining material spaced from both the heat-retaining member and the housing.

6. A device according to claim **5** wherein the sleeve is made from ceramic material.

7. A device according to claim **1** including means for connecting said inlet and said outlet to an internal combustion engine exhaust system.

8. A device according to claim **7** including means for connecting said inlet directly to an internal combustion engine exhaust manifold.

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