

April 29, 1930.

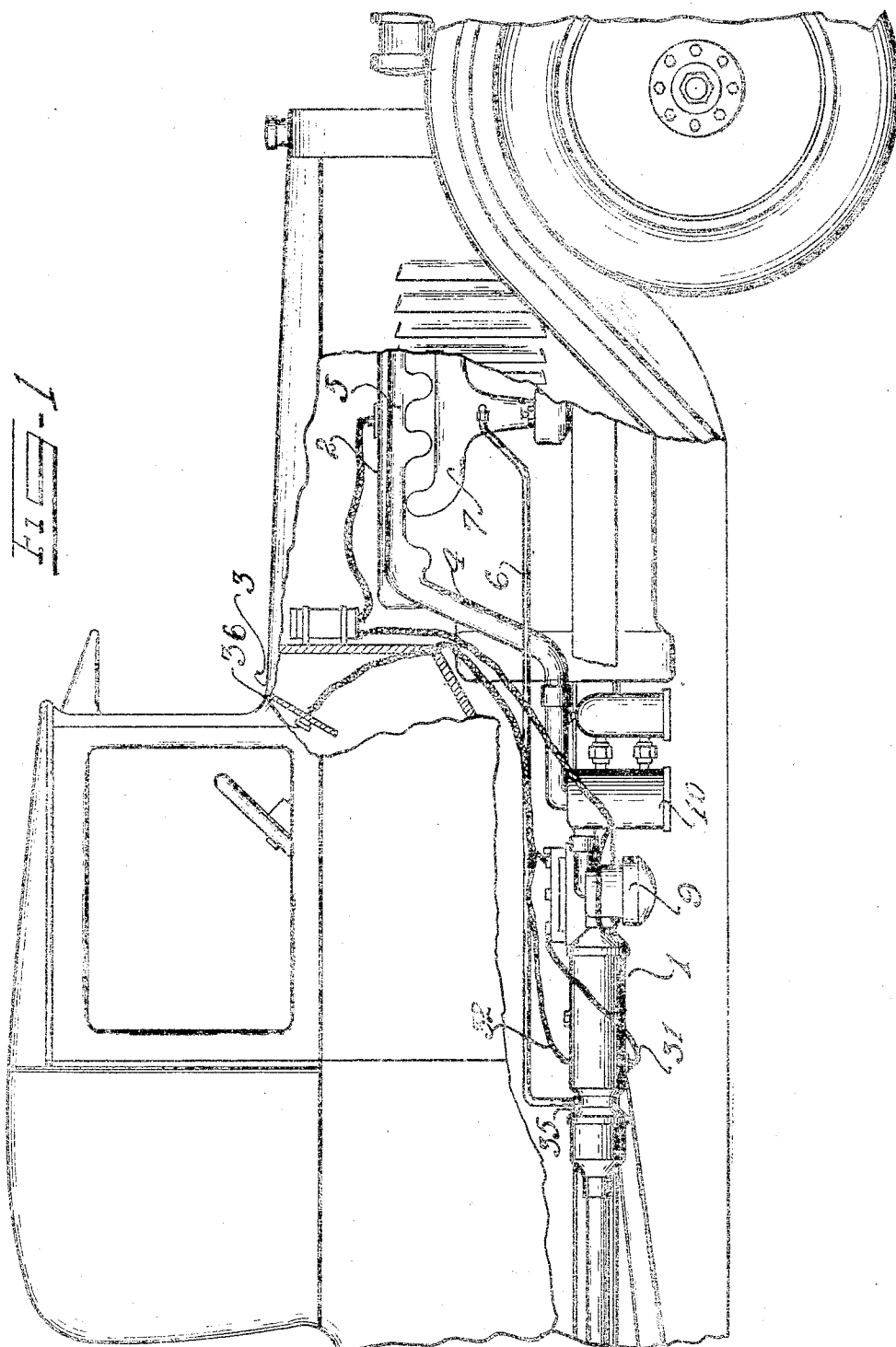
J. BILSKY

1,756,897

METHOD AND APPARATUS FOR UTILIZING EXHAUST
GASES OF INTERNAL COMBUSTION ENGINES

Filed Jan. 16, 1928

4 Sheets-Sheet 1



INVENTOR

Jacob Bilsky

Charles Bilsky

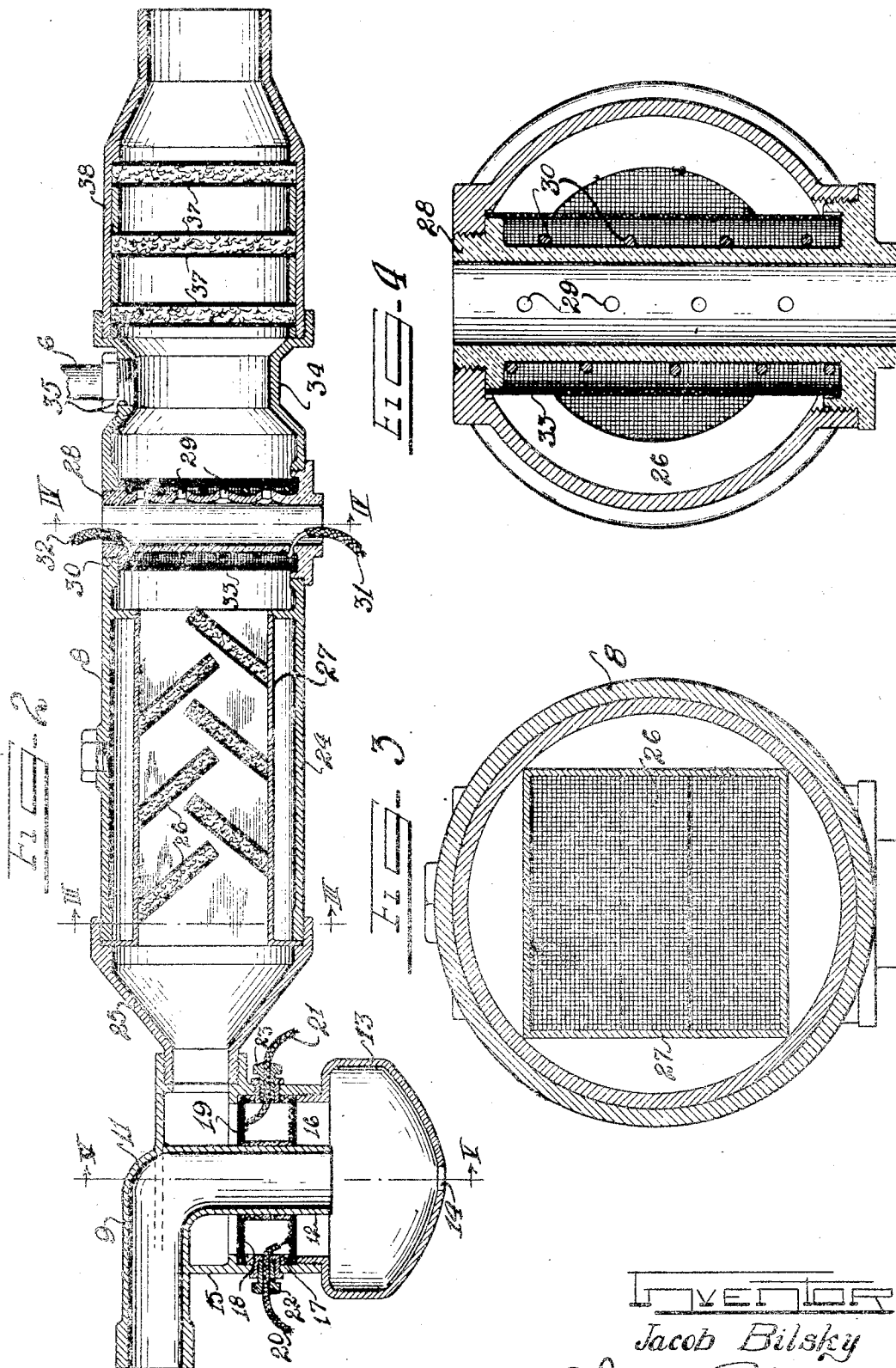
Att'y

April 29, 1930.

J. BILSKY
METHOD AND APPARATUS FOR UTILIZING EXHAUST
GASES OF INTERNAL COMBUSTION ENGINES
Filed Jan. 16, 1928

1,756,897

4 Sheets-Sheet 2



INVENTOR
Jacob Bilsky
Charles Hil
ATTY=

April 29, 1930.

J. BILSKY
METHOD AND APPARATUS FOR UTILIZING EXHAUST
GASES OF INTERNAL COMBUSTION ENGINES
Filed Jan. 16, 1928

1,756,897

4 Sheets-Sheet 3

Fig. 5

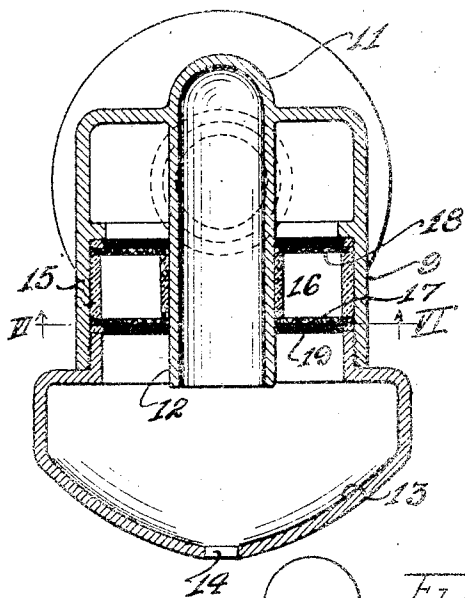


Fig. 6

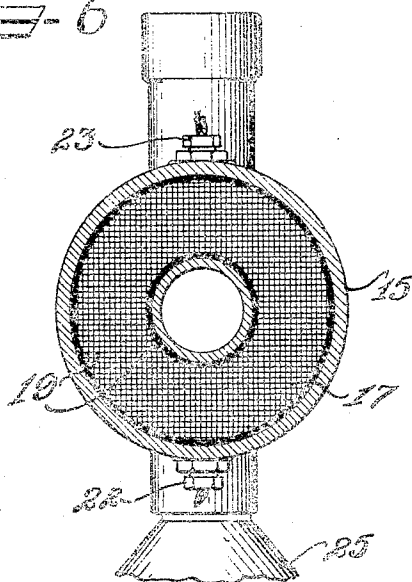
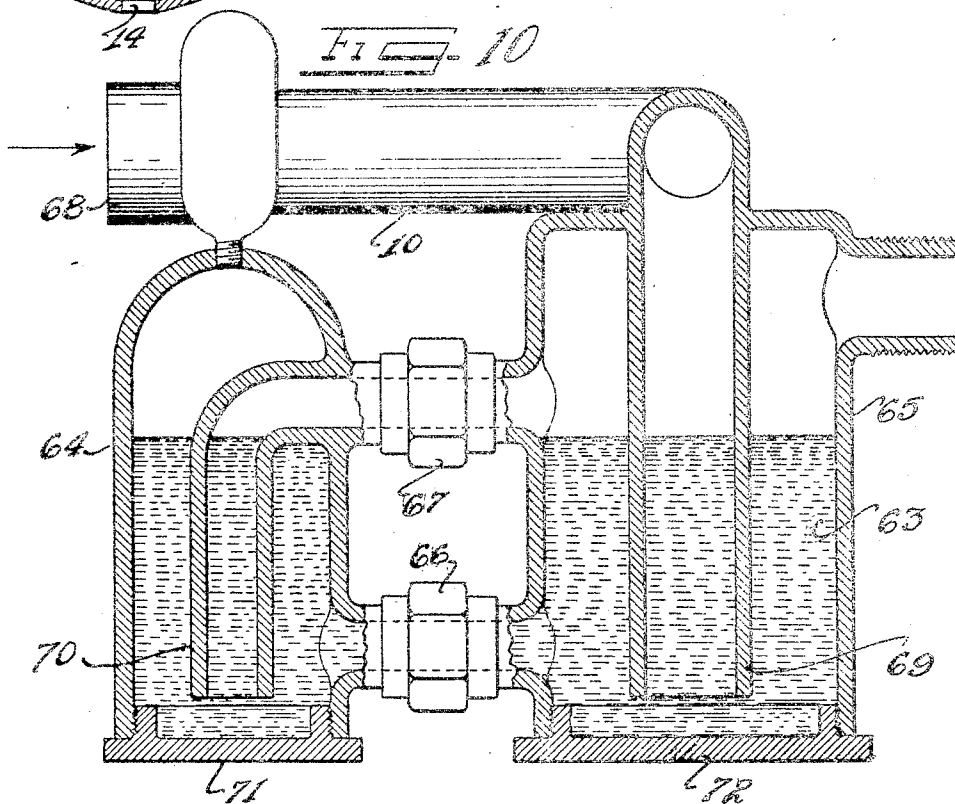


Fig. 10



INVENTOR
Jacob Bilsky

Charles H. Lee

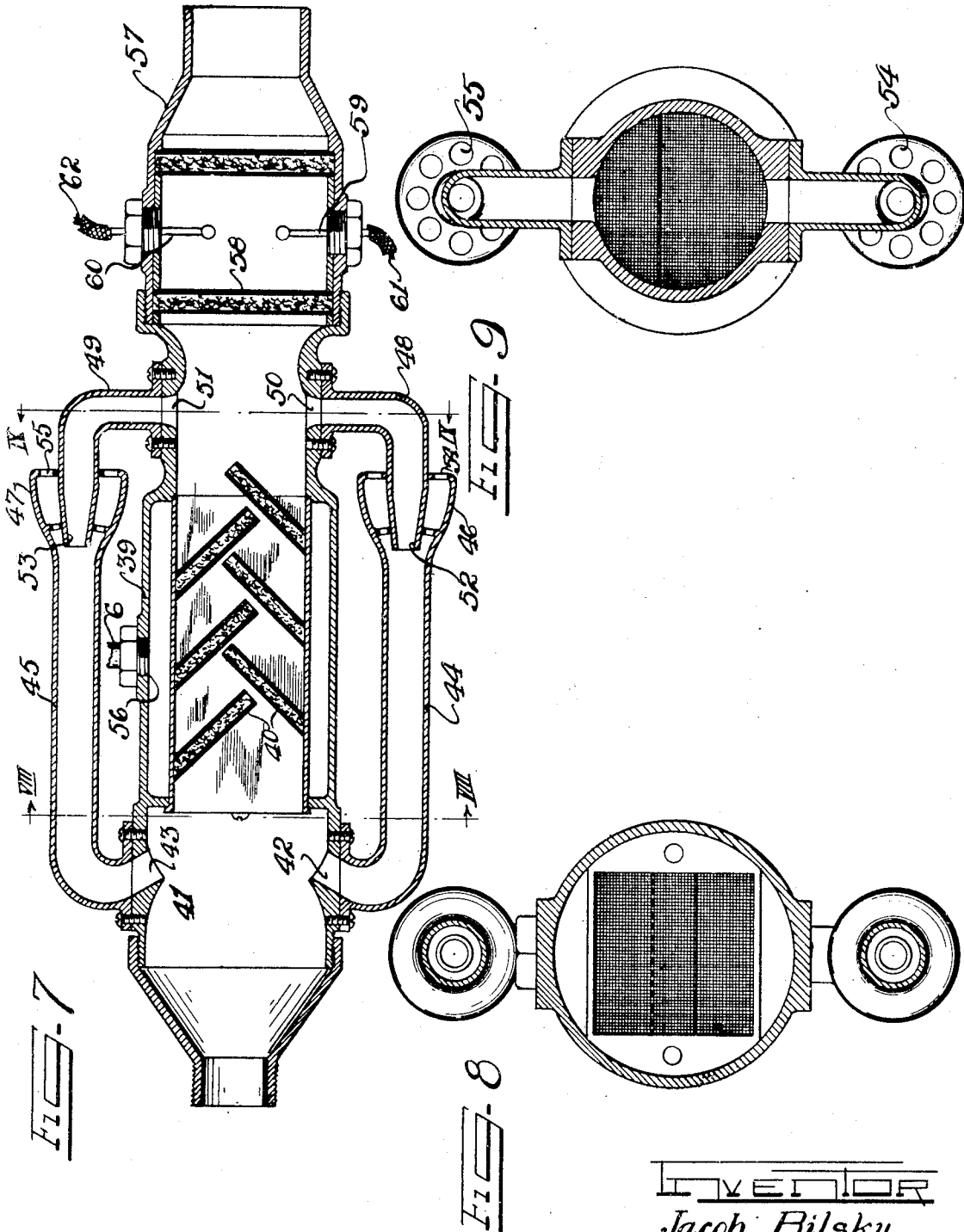
Att'y

April 29, 1930.

J. BILSKY
METHOD AND APPARATUS FOR UTILIZING EXHAUST
GASES OF INTERNAL COMBUSTION ENGINES
Filed Jan. 16, 1928

1,756,897

4 Sheets-Sheet 4



INVENTOR
Jacob Bilsky
Charles H. Miller
ATTY

UNITED STATES PATENT OFFICE

JACOB BILSKY, NOW BY CHANGE OF NAME JOHN GREGORY BILLINGS, OF CHICAGO, ILLINOIS

METHOD AND APPARATUS FOR UTILIZING EXHAUST GASES OF INTERNAL-COMBUSTION ENGINES

Application filed January 16, 1928. Serial No. 247,036.

This invention relates to a method and apparatus for utilizing exhaust gases from internal combustion engines and more particularly to the reutilization in the engine of treated exhaust gases to obtain greater fuel economies and efficiencies.

Heretofore it has been suggested to feed a portion of the exhaust gases back to the engine to utilize the fuel value still remaining in the exhaust gases. In general, however, such re-use of the exhaust gases is impractical for the reason that the gases contain not only particles of unburnt carbon and oil but sulphur compounds that have a very detrimental effect upon the cylinders, pistons and the like.

It is therefore an object of this invention to provide a method and apparatus for utilizing the exhaust gases, wherein means are provided for removing detrimental constituents from the exhaust gases prior to re-use.

It is a further important object of this invention to provide a method and means for re-utilizing exhaust gases in the engine to effect greater fuel economies and efficiencies.

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

This invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a side elevational view illustrating one application of my invention upon an automobile, with parts broken away and in section.

Figure 2 is a longitudinal sectional view of my device.

Figure 3 is an enlarged sectional view taken on line III—III of Figure 2.

Figure 4 is an enlarged sectional view taken on line IV—IV of Figure 2.

Figure 5 is an enlarged sectional view taken on line V—V of Figure 2.

Figure 6 is a sectional view taken on line VI—VI of Figure 5.

Figure 7 is a longitudinal sectional view of a modified form of my device.

Figure 8 is an enlarged sectional view taken on line VIII—VIII of Figure 7.

Figure 9 is an enlarged sectional view taken on line IX—IX of Figure 7.

Figure 10 is a longitudinal sectional view of a washing apparatus for use with my device, with parts in elevation.

The reference numeral 1 indicates as a whole a device embodying the principles of my invention as used in connection with the internal combustion engine 2 of an automobile 3. It will be understood, however, that my device is equally applicable to stationary internal combustion engines. The device 1, as shown, is adapted to be inserted in the exhaust pipe 4 running from the exhaust manifold 5 to the rear of the automobile, where the exhaust gases are vented to the atmosphere. The exhaust gases from the engine 2 are thus all passed through my device, wherein the entrained particles such as carbon, oil residues and the like, as well as sulphur containing compounds, are removed. A pipe 6 serves to conduct a portion of the treated gases from the device 1 back to the intake manifold 7, or to any suitable point on the intake line to the engine, such as the carburetor.

The device 1, as best shown in Figures 2 to 6 inclusive, comprises, in its preferred form, a hollow sectional casing 8, having attached at its intake end a catch-basin 9. Said catch-basin 9 may be directly connected to the exhaust pipe 4 or may be connected through a washing filter 10 (Figs. 1 and 10) as desired. The washing filter 10 will be hereinafter more fully described.

The catch-basin 9 comprises an elbow 11 having a downwardly turned portion 12 for discharging the exhaust gases into a removable trap 13. Said trap 13, which is provided with a small drain opening 14, is adapted to be threaded into a shell 15 surrounding said downwardly turned portion 12 and forming a passage 16 therebetween for the exit of gases from said catch-basin. Within the passage 16 are positioned two spaced screens 17 and 18 insulated from the walls of the shell 15 and the elbow portion 12 by means of insulation 19. The lower screen 17 is preferably of larger mesh than the upper screen 18, for

a purpose that will later appear. Said screens 17 and 18 are connected by means of wires 20 and 21, respectively, passing through suitable bushings 22 and 23 to an outside source of high potential electricity. It is thus possible to charge the screens 17 and 18 with high voltage electricity in order to create brush and corona discharges to ionize the gas passing between the screen electrodes. These electrodes maintain a silent or glow discharge. The entrained particles of carbon and oil residues in the exhaust gases are thus given an electrical charge by contact with the ionized gases and collect together according to well-known principles. The particles so collected will be deposited upon the lower screen 17, which is of larger mesh and will serve to allow some of the particles to fall through into the trap 13. The upper screen 18 prevents the carrying along of the particles into the main portion of the gas absorbing device 1.

The hollow casing 8 is formed with a tubular section 24, removably connected at one end to a flared conical section 25, which in turn is connected to the catch-basin 9. A plurality of hollow baffles 26 arranged in open staggered relation and supported from a frame 27 are adapted to be positioned within said tubular section 24. Each of the hollow baffles 26 is filled with absorbent material capable of removing sulphur containing compounds from the exhaust gases. The absorbent material may suitably comprise a mixture as follows:

	Parts
Sodium ethylate	25
Calcium oxide	5
Strontium oxide	5
Ferric oxide	25
Animal charcoal	25
Asbestos fibre	10

The sodium ethylate serves to absorb sulphur dioxide if present in the gases and also acts catalytically. The iron oxide acts to absorb any hydrogen sulphide present, the alkaline earth oxides act to neutralize the sulphur acids in the gases and the charcoal as a general absorbent for gases.

After passing through the hollow baffles 26 the treated exhaust gases may suitably be heated and mixed with air before being returned to the engine or discharged from the device. Means for admitting air into the casing 8 comprises a hollow tube 28, formed of porcelain or the like, inserted in said casing 8 at right angles thereto and provided with apertures 29 to admit air into the inside of said casing. Said apertures 29 are preferably positioned on the side of the tube 28 toward the discharge end of the device, so that the air will be drawn in by the suction of the exhaust gases in passing through the device. In order to heat the admitted air,

said tube 28 is wound with coils of a resistance wire 30 connected by means of wires 31 and 32 to any suitable source of current. A relatively larger cylinder 33, formed of foraminous material surrounds said tube 28 and heating coil 30 in order to prevent possible ignition of the exhaust gases, in accordance with the principles of the miner's lamp.

Beyond the tube 28 the casing 8 is provided with a restricted portion 34 having an opening 35 in the wall thereof for connection to the pipe 6 leading to the intake of the engine. A certain portion of the exhaust gases will thus be drawn back into the engine together with the usual fuel mixture and the heat value of the unburned portion of the exhaust gases thereby utilized. Inasmuch as the portions of the exhaust gases so fed to the engine are free from entrained particles of carbon, oil residues and the like and from corrosive sulphur-containing gases, greater fuel efficiency can be realized without injury to the engine cylinders. At the same time the added heat supplied to the fuel mixture serves, especially in cold weather, to vaporize the fuel more completely. A switch 36, (Fig. 1) may be provided for cutting out the heating coils 30 when it is not desired to heat the incoming air.

Before the waste gases are finally discharged from the device 1, they are passed through successive hollow baffles 37 arranged within an extension 38 to the casing 8. Said hollow baffles 37 are preferably filled with catalytic materials, such as platinum or palladium asbestos, cuprous or cupric oxide, platinum, palladium, thorium or zirconium wire, or zirconium oxide. The platinum or palladium asbestos serves to oxidize the carbon monoxide and methane in the exhaust gases and the copper oxides to react with the carbon monoxide in case the supply of air is not sufficient for a complete oxidation of the monoxide to the dioxide. The gases as they are finally discharged into the atmosphere are thus purified of poisonous constituents.

In the modified form of my device, as illustrated in Figs. 7 to 9 inclusive, a hollow casing 39 corresponds to the casing 8 above described. Said casing 39 is provided with baffles 40 as before, but the air is admitted to the inside of the casing in a different manner. The intake end of the casing 39 is formed with a slight restriction, as at 41, beyond which are provided passages 42 and 43 extending through the wall of said casing at a slight angle in the direction of the flow of the gases. Pipes 44 and 45 communicate on the outside with said apertures 42 and 43, these pipes being provided with enlarged open ends 46 and 47, respectively. Pipe elbows 48 and 49 are secured to said casing 39 at points beyond the baffles 40 and communicate with the interior of said casing 39 through apertures 50 and 51 respectively.

Said elbows 48 and 49 are provided with reduced ends 52 and 53, respectively, which are adapted to extend into the enlarged ends of the pipes 44 and 45 to provide openings 54 and 55 around said reduced ends. It will thus be obvious that the flow of gases through the casing 39 will result in sufficient suction beyond the restricted portion 41 to draw fresh air through the openings 54 and 55 into the pipes 44 and 45 and thence to the interior of said casing 39. A certain amount of exhaust gases will be drawn through the openings 50 and 51 and elbows 48 and 49, respectively, into the pipes 44 and 45 to be mixed with the incoming air. The mixture of exhaust gases and air thus formed may be drawn from the casing 39 through an opening 56 into the pipe 6 and thence to the engine intake to be utilized as before. An added section 57 on the casing 39 is provided with hollow baffles 58 containing catalytic and oxidizing materials. In this case, however, spaced terminals 59 and 60 are positioned between said hollow baffles 58 and connected by wires 61 and 62 respectively to a suitable source of high potential electricity to provide an ozone spark. The purpose of this is to aid the catalytic and oxidization materials in the converting of carbon monoxide to carbon dioxide.

As mentioned above, a suitable washing filter (Fig. 10) may be used ahead of the device 1, this washing filter to be filled with a fluid 63, such as tetrahydronaphthalene, capable of reacting with and absorbing sulphur containing compounds. The filter 10 comprises separate chambers 64 and 65 connected at spaced points by unions 66 and 67. Gases are led into the chamber 65 through a pipe 68 having a vertical portion 69 extending beneath the level of the fluid 63. As the level in the chamber 65 rises, due to pressure, or accumulation of condensate, the fluid passes over into the chamber 64 through the union 67 and a pipe 70 leading to the bottom of said latter chamber. Both of said chambers 64 and 65 are provided with removable caps 71 and 72 to permit the fluid 63 to be drawn out. The filter 10 thus serves as an additional means for removing sulphur containing compounds from the exhaust gases. At the same time when tetrahydronaphthalene is used as the filter fluid, if any of the fluid is entrained in the exhaust gases and carried back to the engine, no harm results, since tetrahydronaphthalene is itself a combustible substance suitable for use in internal combustion engines.

This application constitutes an improvement upon my copending application entitled: "Process of purifying the exhaust gases from internal combustion engines", Serial No. 205,319, filed July 13, 1927, now Patent No. 1,716,481, issued June 11, 1929.

I am aware that many 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 necessitated by the prior art.

I claim as my invention:

1. The process of utilizing the exhaust gases from an internal combustion engine, which comprises filtering said gases to remove sulphur-containing compounds and returning a portion of the gases for re-combustion in said engine.

2. The process of utilizing the exhaust gases from an internal combustion engine, which comprises electrically removing entrained particles from the exhaust gases, filtering said gases to remove sulphur containing compounds and returning a portion of the gases for recombustion in said engine.

3. The process of utilizing the exhaust gases from an internal combustion engine, which comprises electrically removing entrained particles from the exhaust gases, filtering said gases to remove sulphur containing compounds, introducing a gaseous oxidizing medium into said gas flow, and returning a portion of the gases for re-combustion in said engine.

4. The process of utilizing the exhaust gases from an internal combustion engine, which comprises subjecting said gases to an electrical silent discharge to precipitate solid particles, carbon residues and the like, filtering the treated gases to remove sulphur containing compounds, introducing air into the flow of gases and returning a portion of such gases to the intake to the engine.

5. The process of purifying and utilizing exhaust gases from internal combustion engines, which includes filtering and washing said gases to remove sulphur-containing compounds and returning a portion of the thus purified gases to the engine.

6. The process of purifying and utilizing exhaust gases from internal combustion engines, which comprises treating said gases with tetrahydronaphthalene to remove oily residues and sulphur-containing compounds and returning a portion of the thus purified gases to the engine.

7. The process of utilizing the exhaust gases from an internal combustion engine, which comprises filtering the exhaust gases to remove sulphur containing compounds, introducing air into the flow of filtered gases and returning a portion of the mixture of air and filtered gases thus formed to the engine.

8. The process of utilizing the exhaust gases from an internal combustion engine, which comprises filtering the exhaust gases to remove sulphur containing compounds, introducing air into the flow of filtered gases, heating the mixture thus formed, and return-

ing a portion of the heated mixture to the engine.

9. In a device for utilizing exhaust gases from internal combustion engines, means for filtering the gases to remove sulphur-containing compounds, and means for conducting a portion of the filtered gases back to the intake of the engine.

10. In a device for utilizing exhaust gases from internal combustion engines, means for filtering the gases to remove sulphur containing compounds, electrical means for precipitating entrained particles from the gases, and means for conducting a portion of the filtered gases back to the intake of the engine.

11. In a device for utilizing exhaust gases from internal combustion engines, means for filtering the gases to remove sulphur containing compounds, electrical means for precipitating entrained particles from the gases, means for introducing a gaseous oxidizing medium into the gas flow, and means for conducting a portion of the filtered gases back to the intake of the engine.

12. A device for utilizing the exhaust gases from an internal combustion engine, comprising a hollow casing adapted to be inserted in the exhaust pipe from the engine, hollow baffles arranged in said casing and containing absorbent material, means for admitting air into said casing, and a conduit leading from said casing to the intake of the engine.

13. A device for utilizing the exhaust gases from an internal combustion engine, comprising a hollow casing adapted to be inserted in the exhaust pipe from the engine, hollow baffles arranged in said casing and containing absorbent material, means for admitting air into said casing, electrical means for heating the admitted air, and a conduit leading from said casing to the intake of the engine.

14. A device for utilizing the exhaust gases from an internal combustion engine, comprising a vessel containing a washing fluid and adapted to be inserted in the exhaust pipe from the engine, a hollow casing connected to said vessel, baffles arranged in said casing, means for admitting air to said casing and a conduit connecting said casing to the intake of the engine to return a portion of treated exhaust gases to said engine.

15. A device for utilizing the exhaust gases from an internal combustion engine, comprising a vessel containing a washing fluid and adapted to be inserted in the exhaust pipe from the engine, a catch basin communicating with the outlet of said vessel, a hollow casing, a conduit between said catch basin and said casing having spaced screens therein, baffles arranged in said casing, means for admitting air to said casing and a conduit connecting said casing to the intake of the engine to return a portion of treated exhaust gases to said engine.

16. A device for utilizing the exhaust gases

from an internal combustion engine, comprising a vessel containing a washing fluid and adapted to be inserted in the exhaust pipe from the engine, a catch basin communicating with the outlet of said vessel, a hollow casing, a conduit between said catch basin and said casing having spaced screens therein, means for electrically charging said screens, baffles arranged in said casing, means for admitting air to said casing and a conduit connecting said casing to the intake of the engine to return a portion of the treated exhaust gases to said engine.

In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, Illinois.

JACOB BILSKY.

85

90

95

100

105

110

115

120

125

130