

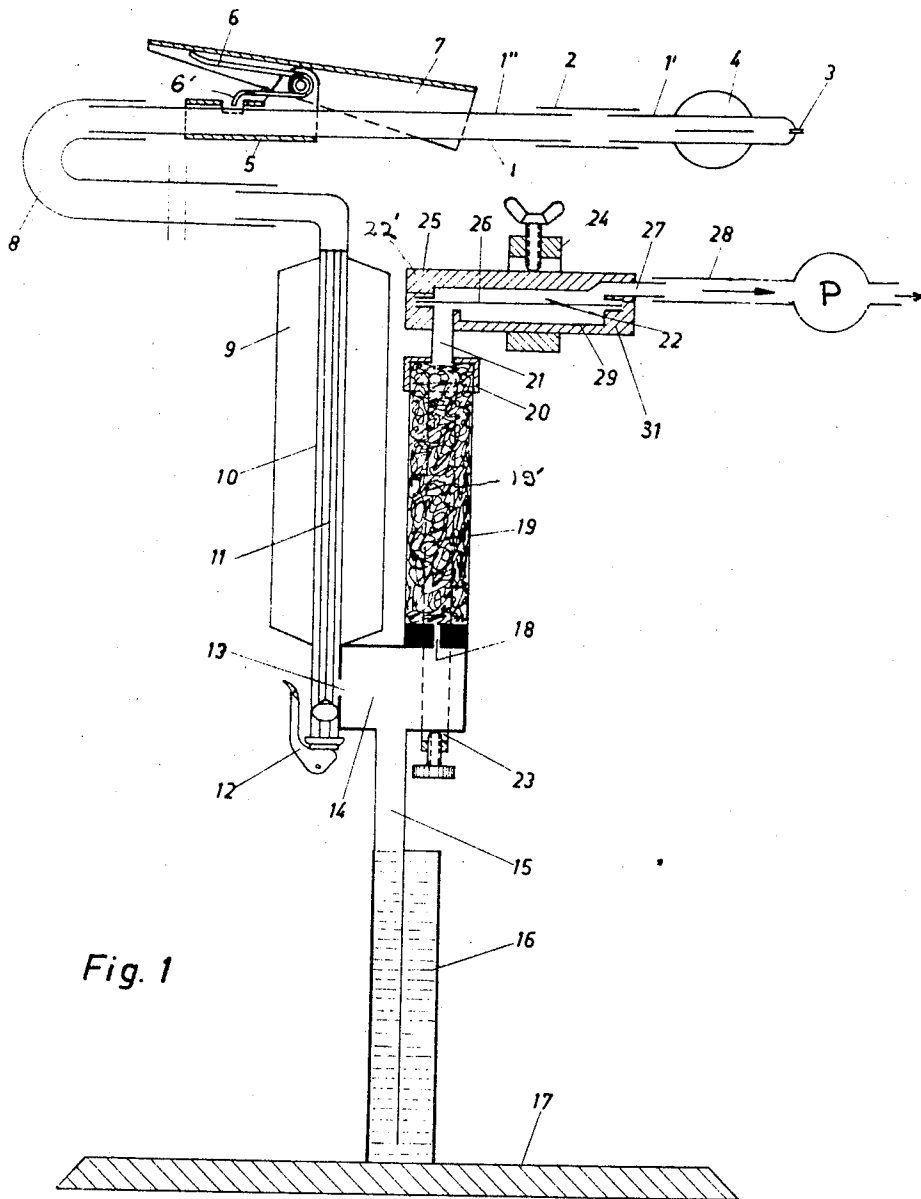
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HEINZ-JÜRGEN LÜDECKE ET AL 3,481,200

EXHAUST GAS SAMPLER

Filed Oct. 1, 1968

2 Sheets-Sheet 1



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Fig. 2

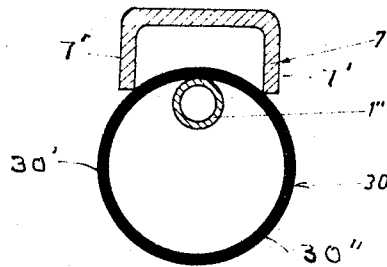
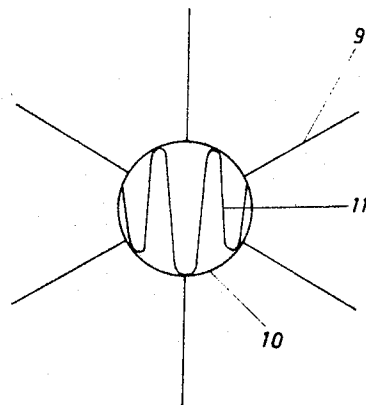


Fig. 3



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EXHAUST GAS SAMPLER

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6 Claims

ABSTRACT OF THE DISCLOSURE

Internal combustion motor exhaust sampler and cleanser for protecting gas analyzer equipment wherein a probe tube is inserted into exhaust pipe. Exhaust passes downwardly through condenser, thence through large chamber and then upwardly through filter means. Condensate drains from condenser and chamber into syphon trap.

BACKGROUND OF THE INVENTION

Field of the invention

Exhaust gas sampler with means to detain condensable and solid components.

Description of the prior art

Probing devices for exhaust gas are known but their use has practical restrictions. For instance the sampling probes are not adapted to be used on more than one shape of exhaust pipe. Moreover delicate gas testers or analyzers often require a metering pump just ahead of the tester, or at least a pump to draw gas from the cleansing device so as to avoid being dependent on positive pressure from the exhaust itself since the latter is variable from one engine to another. When condensate or foreign matter enters the pump the analyzer gives false readings or may be permanently damaged. Moreover it is often the case that a stoppage near the entrance to the probe tube causes unwanted air to be drawn into the pump and meter without its being detected unless by obviously false readings. Additionally, the hitherto sampling devices were not rugged, were difficult to maintain, and inconvenient to use. All the above named objections are greatly minimized by the invention.

SUMMARY OF THE INVENTION

The exhaust sampling device has an articulated probe tube insertable into an exhaust pipe where it is held by a clamp. Exhaust sample then is passed downwardly through a cooler to remove condensable components, thence through and across a safety chamber into the lower part of a directly adjacent coarse vertical filter and upwardly to a fine filter. Condensable components, mostly water, drain from the cooler and chamber into a syphon trap. The trap is composed of vertical tubes, one within the other, and mounted on a base. Provision is made for easy cleaning of the cooler and quick replacement of filtering media.

DESCRIPTION OF THE DRAWING

FIG. 1 shows the sampling and cleansing device.

FIG. 2 is a cross section of the exhaust pipe showing the probe tube therein held by the clamp; and

FIG. 3 is a cross section of the vertical filter.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 a sampling probe tube generally designated 1 is made up preferably of head and tail copper tube

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sections 1' and 1'' connected together by a short flexible tube section 2. By a suitable choice of lengths of the above tube sections, the sampling tube as a whole can be inserted without difficulty into exhaust pipes bent into otherwise unfavorable shapes. The head section 1' is provided with a foremost gas opening 3 and radially projecting skid members 4 to enable the insertion of the sample tube into an exhaust or tail pipe 30 (FIG. 2) and to hold the opening 3 well spaced from the inner wall of the pipe.

The rear end portion of the tail section 1'' is provided with an adjustably positionable sleeved bracket member 5 carrying a biased clamp member 7 of somewhat inverted U-shape tending to engage on the section 1'' between the bracket member and the connector 2 under the action of a spring 6. This is so that when the sampling tube is inserted in the exhaust or tail pipe 30 as shown in FIG. 2 the side flanges 7' of the clamp bear down on the outer wall 30' of the pipe holding the tube section 1'' in engagement with the inner wall 30'' of the pipe and so hold the sampling tube therein. The force of the tube can be so chosen that the clamp will not damage a badly corroded pipe.

Gas from the sampling tube 1 flows by means of a long hose or tube 8 to enter the top of, and flow downwardly through, a vertical barrel cooling tube 10 provided with exterior fins 9. A condensing foil or sheet 11 is inserted in the cooling tube from beneath, and is held fast by means of a quick acting spring lock 12 which additionally provides the sealing off of the exterior. By means of an opening 13 in the lower portion of the cooling tube the gas then flows into a chamber 14 which a downwardly open tube taps and seals off at the bottom of the chamber. The condensate that forms in the cooling tube collects in the tube 15, the latter being situated in an upright tube 16 open at the top and of greater diameter than the tube 15. The tube 15 does not reach the bottom of the tube 16 and so the two tubes in combination form an overflow vessel or syphon trap.

The tube system 15 and 16 mounted on a base plate 17, enables the sampling device to fail or plug amply close to the exhaust pipe during the exhaust gas analysis. Precautions for the catching of overflowing condensate are not provided since this is not necessary.

The foil 11 on which the condensation is to take place in the condenser can be, for example, corrugated with the continuous folds in contact with the condenser shell as shown in FIG. 3 to improve thermal contact between the fold and shell and vertical fins. The fins, being in vertical planes, allow heated ambient air to rise unhindered to permit quick cooling.

The gas, freed from condensable components, passes upwardly through the opening 18 of the chamber 14 into the adjacent upright filter tube 19 filled with wadded packing 19', the gases flowing from below and upwardly. The upper end of the tube 19 is fitted with a closure plate 20 provided with a short conduit connector 21 which leads the gases to the housing 22' of a membrane filter 22 for screening out fine particles. Soot or smoke particles are removed from the gas by these two filters. Screen tensioned clamps or shackles 23 and 24 are provided for the tube 19 and housing 22' for quick changing of the wadding and membranes.

The shackle 23 for the filter tube bears on the plate 21 and embraces the chamber 14 while the shackle 24 for the membrane filter 22 embraces the two housing parts 25 and 31 holding the membrane stretched therebetween. An exit means 27 on the upper half 25 of the housing leads the gas from the membrane filter to an analyzer or tester not shown, the flow rate being made uniform by a controlled suction pump.

The chamber 14 serves as a safety vessel for conditions when a stoppage occurs in the sampling tube ahead of the condenser with the result that condensate in the overflow vessel or trap is sucked upwardly into the safety chamber. Without the chamber the condensate could be carried out through the opening 27 and into the pump and analyzer. Errors in measurement, and under certain conditions, complete failure of the apparatus, would then be the result if condensate were not held back.

The size of chamber 14 is about double the volume of the condensate that can be contained in the tube system 15 and 16. The condensate can then entirely flow up into the chamber and never reach the outlet 28 and hence prevent the condensate entering the pump or analyzer.

Of course when the pump draws out all the condensate from the outer tube 16 into the chamber 14, outside air will then bubble through the condensate and a small amount of condensate be entrained with the air. Therefore a second smaller safety trap or container in the form of a depression 29 is provided in the lower half of the housing for the membrane filter to collect any entrained condensate.

In use, the sampling tube 1 is first inserted into the tail or exhaust pipe 30 to an extent sufficient to enable the inlet 3 to receive a fair sample of the exhaust gas. If necessary, the sleeved bracket 5 is slid longitudinally on the tube section 1" so as to enable the clamp 7 to bite the end portion of the pipe. In clamping position the end 6' of the spring 6 will bear upon the tube section 1" and tend to prevent slippage of the bracket thereon so that gases will not blow the probe from the pipe.

A metering pump and tester connected in the exit conduit 28 will draw sufficient gas all through the shown system for desired analysis after the trap 15 and 16 has received sufficient condensate or added liquid to become sealed. A stoppage due to soot, carbon, rust and the like ahead of the trap will cause the condensate to be sucked into the chamber 14 and yet the pump will be protected.

The unitary structure of the trap condenser, filters on the base plate 17 enable the device to be situated almost anywhere near the exhaust pipe. The conduit 28 may be flexible and of almost any desired length, provided adequate mounting of the pump is assured.

The condenser foil or sheet may be removed by loosening the latched seal 12 to examine for excessive soot and any necessary cleaning.

What is claimed is:

1. A sampling device for internal combustion motor exhaust gases comprising a probe tube insertable into a pipe from which the gases issue and smaller than the pipe, a vertical cooling condenser generally near the tube, a relatively long hose connecting the probe tube to the condenser at the upper end portion of the latter, a settling chamber at the lower end portion of the condenser tube

and having an opening in communication with the lower end portion of the condenser, a filtering device mounted on the chamber and directly adjacent the condenser, the lower portion of the filtering device and the upper portion of the chamber being provided with a common gas passageway therebetween, the opening and passageway being spaced from each other so that matter passing from the condenser to the filtering device will traverse at least a part of the interior of the settling chamber, and a liquid syphon trap under and connected to the bottom of the chamber for receiving liquid condensate formed in the condenser and passing into the chamber and for normally sealing the chamber off from the atmospheric air.

2. A sampling device as claimed in claim 1, said trap being formed by an upwardly open vertical tubular vessel and a downwardly open vertical drain tube of smaller diameter than the tubular vessel and connected to the chamber and in the vessel, and a base plate for the vessel.

3. A sampling device as claimed in claim 2, the filtering device including a coarse filter nearer the chamber and a subsequent serially connected fine membrane filter.

4. A sampling device as claimed in claim 2, said condenser being of cylindrical shape and provided with exterior fins in vertical planes and an interior slidably received corrugated condensation sheet having lines of contact along the corrugation thereof with the inner wall of the condenser, and latched plate means at the lower end of the condenser for holding the sheet in the cylinder.

5. A sampling device as claimed in claim 1, the probe tube being of head and tail sections of copper tubing and a flexible tubular connector connecting the sections, so that the probe tube as a whole may yield to accommodate itself to a greater variety of shapes of exhaust pipes.

6. A sampling device as claimed in claim 5, the tail section being provided with a sleeved bracket slidable thereon, a generally inverted U-shaped clamp mounted pivotally on the bracket and providing side flanges, a spring on the clamp tending to turn the flanges to embrace the tail section and bearing on the latter to tend to prevent the bracket from slipping on the tail section, whereby when the probe tube is inserted in the pipe the bracket may be positioned for the flanges of the clamp to bear against the outer wall of the pipe and force the tail section against the inner wall of the pipe and hold the probe tube in the pipe.

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