United States Patent

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[54] **TAKEOFF FOR HOT DUSTY GASES**
5 Claims, 2 Drawing Figs.

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[51] Int. Cl. F04f 5/44, G01n 1/24
[50] Field of Search ..... 417/160, 171, 194, 197; 73/421.5 A

[56] References Cited

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ABSTRACT: A takeoff using injector action to aspirate dirty furnace gas from a sample zone and force it to an analyzer. Part of the water used for injector action is used to scavenge and rinse the walls of the gas takeoff passageway, with centrifugal force of water rotation holding the major cross-sectional area of the passageway open. Washing stream is biased to move counter to gas aspiration and leaves the device as a conical water curtain opening toward the furnace.

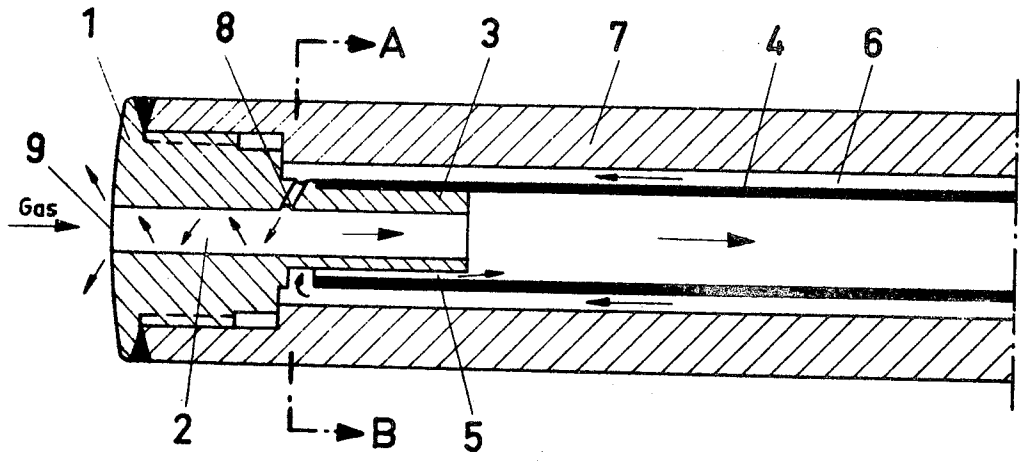


Fig.2

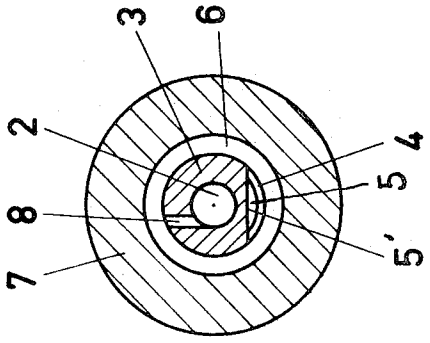
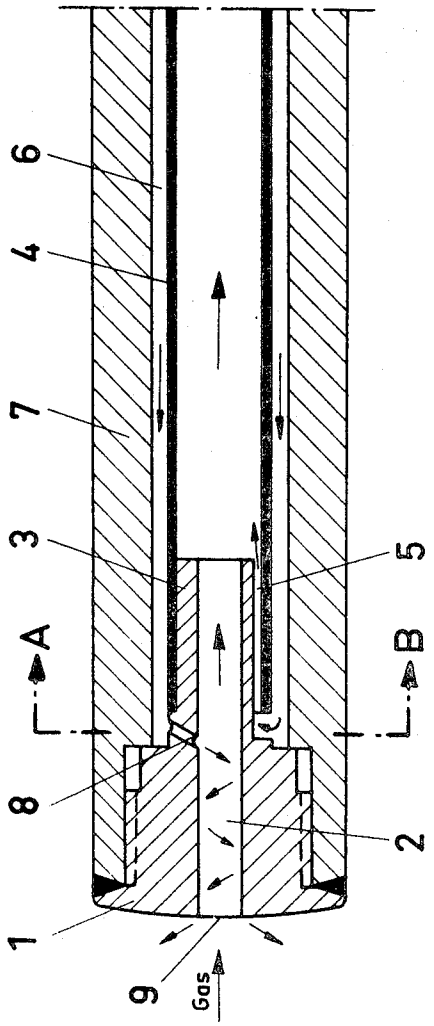


Fig.1



TAKEOFF FOR HOT DUSTY GASES

DESCRIPTION OF THE PRIOR ART

Devices for the extraction or taking off of very hot dust-laden flue or exhaust gas from furnaces are beset with extraordinarily unfavorable operation. The high temperatures in combination with condensable and corrosive flue gas components cause a very marked strain and demand on the material used in the pickup part projecting back into the furnace. By careful selection of materials and use of cooling water, abrasion and corrosion are reduced to a tolerable but generally unsatisfactory amount. Great difficulties have been encountered in insuring the takeoff tube over long periods of service against at least partial stoppage by small solid particles from the flue gas, which particles, in combination with condensable other components cause deposits and incrustations. It is possible, of course, to keep the takeoff tube open by pushing an iron rod through the tube, but this is most inconvenient and a costly way of maintenance. Besides, dislodged particles can remain in the takeoff tube and cause disturbances in the taking off of the gas samples.

In order to extend the useful life of the takeoff device, it has been the practice to apply wash water to the device. The wash water is intended to reduce formation of encrustations inside the takeoff tube and it also enables the picking up and washing away of solid particles drawn in with the flue gas.

Such a flue gas takeoff for very hot and dust-laden gas is described in German Pat. No. 953,926 wherein the takeoff tube has nozzles or an annular space directly at the gas entrance opening, the nozzles or space providing for the injection of scavenging water in a second tube to flow in the direction of the gas stream. The gas is aspirated by the injector action of the water stream and led to gas analyzing instruments without further transport means, the injector action giving sufficient movement to the gas. The injected water rinses the inner wall of the forward part of the takeoff tube and reduces the tendancy there toward clogging by deposits of solid particles from the flue gas. But there is, of course, the ever present danger that the solid particles will become fixed on the foremost nozzle rim and cause a slow incrustation of the inlet opening or, with the action of the water, lead to erosion and consequently shorten the operative life of the device.

Another takeoff using wash water is described in U.S. Pat. No. 2,550,933 which has a central water supply tube provided with a bulge shortly ahead of the forward opening with several nozzles. The water from the nozzles sprays toward the takeoff opening counter to the direction of gas aspiration as well as perpendicular to the walling of the takeoff tube. So much water is sprayed out toward the furnace space, to reduce the obstruction of the takeoff opening, that the active cross section for gas entrance through the bulging of the water supply tube is markedly reduced. Not only that, but the waterflow paths spread out unrestrictedly over the entire entrance opening of the gas intake. The result is that there is really no injector action by the waterflow for subsequent transport of the gas and that a force pump is necessary to convey the gas to an analyzer. The possibility of using self-acting injector effects for aspiration and further conveyance of the gas is not suggested. Such a device, however, is susceptible to the danger that deposits may build up and tend to restrict the active entrance space for the gas and result in a clogging up of the takeoff tube.

The invention has for its object the production of a takeoff device utilizing scavenging water operable for flue gas and the like having a very high proportion of solid particles held in suspension, and in which the defects of conventional devices are not present, and so enable an especially long operable life.

BRIEF DESCRIPTION OF THE INVENTION

The takeoff device includes inner and outer coaxial tubes between which water flows toward the furnace-side end of the two tubes where the flow is reversed to flow outwardly inside the inner tube, and so produces an injector action to aspirate sample flue gas into the inner tube to carry the gas along to a gas-analyzing device. The flue gas is aspirated through a short cylindrical takeoff conduit passageway. The water is injected into the system of the two tubes also in such a way that it acquires substantially rotary momentum about the axis of, and in, the cylindrical passageway and is also forced counter to the direction of gas aspiration so that it leaves the takeoff device in the form of a conical water shield opening toward the furnace space.

A particular form of the invention has a furnace-side end piece of the takeoff device provided with a central bore therethrough as well as through a projection thereon extending into the inner tube, partially closing the latter. This projection is provided with a water inlet bore for leading a part of the water flowing between the two tubes into the passageway somewhat tangentially thereto and counter to the direction of gas aspiration.

BRIEF DESCRIPTION OF DRAWING

FIG. 1 is a partial diametric longitudinal cross-sectional view of the invention, and

FIG. 2 is a cross-sectional view of the invention, the section being taken along the line A–B of FIG. 1, looking in the direction of the arrows of said line.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The takeoff device is closed off at the furnace-side end (to the left in the drawing) by means of a threaded plug **1**. The furnace-side end may be inserted through the walls of the furnace or to a zone providing a representative gas sample. The plug is provided with a central or axially directed bore **2** which forms the gas pickup passageway. The plug is provided with a projection **3** of reduced diameter projecting into an inner tube **4** so that an opening or jet passage **5** remains free in the inner tube **4** of the device. This opening is formed by the removal of a lateral portion of the projection (FIG. **2**) leaving a flat face **5'** parallel with the bore axis and away from the inner wall of the tube **4**. Otherwise, the projection has a tight fit in the inner tube, but spaced from the main body of the plug as shown in FIG. **1**.

The scavenging water, that also effects the cooling of the takeoff device, flows from a supply (not shown) into an annular space **6** between an outer tube **7** on the body of the plug and the inner tube **4**, to the furnace-side end of the device and thence through the opening **5**, being directed in the reverse direction in this annular space **6** at the furnace-side end of tube **4** by striking the main body of the plug **1** at the location of the opening **5** and issuing therefrom as an injector jet. By means of injector action, the flue gas is aspirated through the takeoff passageway **2** and sent through the inner tube **4**, owing to the water stream, on to a gas analysis instrument (not shown). A separate gas conveying pump is not needed.

The projection **3** of the plug **1** is provided with a small side bore **8** through which water arrives from the annular space between the inner and outer tubes **4** and **7** and enters into the gas takeoff passageway **2** so that it wets the inner walls of the passageway with rifling or helical motion, counter to the direction of aspiration of the gas, leaving the gas-entrance opening **9** at the furnace end of the plug in the form of a conically mantled or shaped water shield or curtain opening to the furnace space as indicated by the spreading arrows. This helical sort of scavenging of the gas passageway is effected by having bore **8** enter the passageway somewhat inclined toward the furnace side as shown in FIG. **1** and also more or less tangentially as shown in FIG. **2**. Scavenging of this nature not only has the advantage of preventing deposits from forming in the passageway but also of not hindering the inflow of gas, both of these advantages being due to the fact that the water wets the wall only as a thin moving coating. The gas passageway is therefore not throttled in spite of the wetting and the action of the injectors is not impaired. Furthermore, the aspirated flue

gases are purified at least to some extent by passage through the extending water cone and this is advantageous in protecting the takeoff device as well as reducing the load on subsequent treating means.

The conduction or transport of the gas from the takeoff to gas analyzers is done in known manner after separation of the water in a collecting vessel as well as, in extraordinary circumstances, after purification by a filter. Owing to the intensive scavenging and washing process, filters exhibit neither darkening nor fading over long periods of operation. This shows that the large amount of scavenging and transport water also remove such components from the measuring gas as would disturb the measuring operation of analyzers by deposits or corrosion.

By having the wash water inlet **8** tangential, the wash water rotates in the bore so as to form only a relatively thin sheet of water on the inner walls of the passageway **2**. A slant of the inlet, about 30° being satisfactory, relative to the passageway axis insures that the water move to the water outlet **9** to form the water cone. Increases in pressure on the water in the annular space **6**, producing higher flow velocities through the jet space **5** and greater gas aspiration, also produce greater rotary and longitudinal velocities in the passageway **2** so that increases in the gas aspiration are accompanied by increases of centrifugal force holding the wash water on the passageway walls to keep the passageway effectively open and by more water to stabilize the water curtain.

Preferably, water inlets **5** and **8** open into the space **6** remote from each other so that waterflow at one does not adversely affect pressure at the other.

The length of the gas passageway from side bore to the exterior preferably should not be more than a few centimeters lest the centrifugal action become reduced at the gas opening **9** and allow the water to throttle it. Some swirling water will follow the gas through the extension and so enable the whole passageway **2** to be protected.

The invention I claim is in the following:

1. In a device for drawing very hot dust-laden gas from furnaces for analysis of the gas, inner and outer coaxial tubes having an annular space therebetween, closure means for partially closing the tubes at adjacent ends thereof as furnace-side ends of the device, the closure means being provided with a short cylindrical gas passageway for entrance of the gas from the exterior of the closure means into the inner tube, walled means within the outer tube forming a jet passage communicating between the interior of the inner tube and the annular space for receiving water flowing in the latter toward the furnace-side end and causing the water to issue as an injector jet into the inner tube and aspirate the gas through the gas passageway into the inner tube and force it through the latter, said closure means being provided with a side bore communicating between the annular space and the gas passageway for injecting water into the latter with a rifling action to rinse the walls of the gas passageway and leave the latter as a water curtain having a conical mantle opening toward the furnace.

2. In a device as claimed in claim **1**, said closure means obstructing the flow of part of the water flowing toward the furnace-side end to give the jet reverse motion.

3. In a device as claimed in claim **1**, said side bore joining the cylindrical gas passageway essentially tangentially so that water entering the passageway will tend to become rotated about the axis of the passageway and become centrifugally forced against the walls of the passageway and leave the more central zone open for said entrance of the gas.

4. In a device as claimed in claim **3**, the side bore being inclined toward the furnace-side end at the interior of the gas passageway so that water swirling at the walls thereof will be biased to move counter to the direction of aspiration of the gas and leave the closure means as said conical curtain.

5. In a device as claimed in claim **4**, said closure means being a plug closing the outer tube and provided with an inner extension of reduced diameter projecting into the inner tube, the gas passageway being an axial bore through the plug extension, the extension being provided with a lateral cutaway forming a wall thereon which with the inner wall of the inner tube constitute said walled means, and said side bore being through the extension.