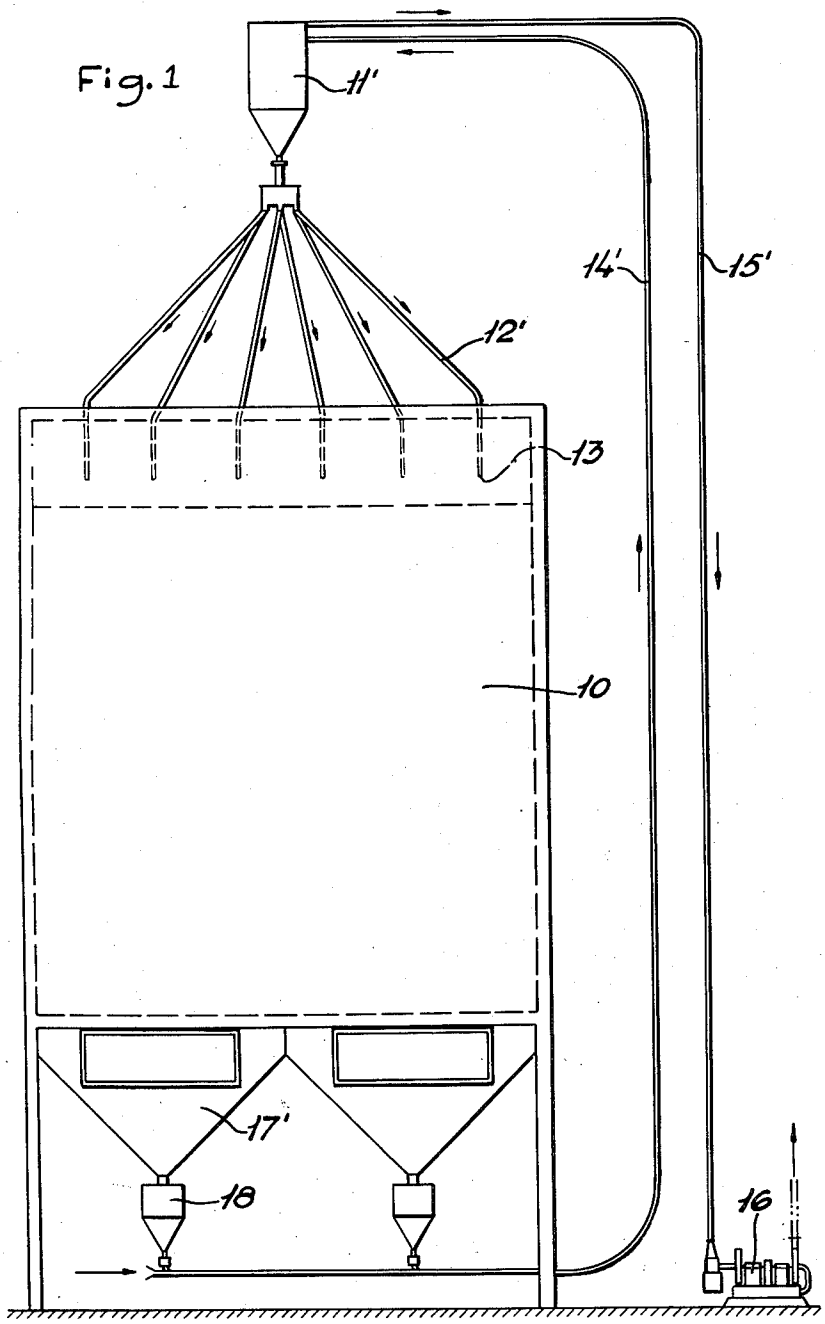
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METHOD FOR CLEANING GAS-SWEPT HEATING SURFACES

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Fig. 1



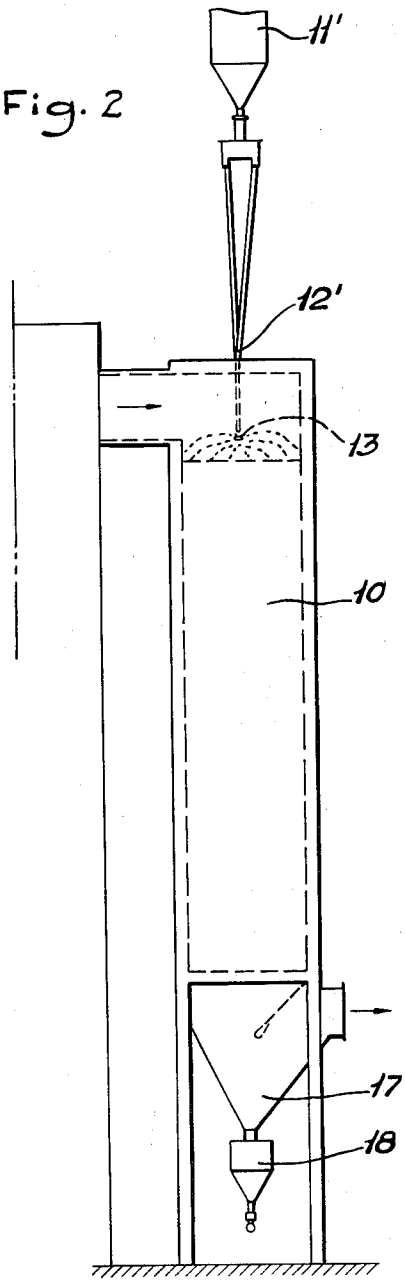
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Fig. 2



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2,792,316

METHOD FOR CLEANING GAS-SWEPT HEATING SURFACES

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Application February 1, 1954, Serial No. 407,439

Claims priority, application Sweden February 2, 1953

3 Claims. (Cl. 134—7)

The present invention relates to a method for cleaning the heating surfaces of boilers, heat exchangers and other kindred apparatus.

More particularly, this invention relates to a method for cleaning gas-swept heating surfaces in which solid cleaning particles such as steel pellets or shot are cascaded through the apparatus to be cleaned and impinge and ricochet against the heating surfaces within the apparatus to pick up by such impact any material deposits on the heat exchange surfaces and to prevent the accumulation of such deposits or coatings.

The arrangement of the present invention constitutes an improvement over the method and apparatus disclosed in my prior Patents 2,665,118, Apparatus for Cleaning Gas-Swept Heating Surfaces, and 2,665,119, Method and Apparatus for Cleaning Gas-Swept Heating Surfaces, both issued January 5, 1954.

Additionally, the present invention incorporates some of the arrangement embodied in my prior filed application Serial No. 320,333 filed November 13, 1952, and entitled Apparatus for Distributing Cleaning Particles Over Gas-Swept Surfaces in Heat Exchangers and the Like.

In following the teachings of my prior patents, the cleaning pellets or shot which have been effectively distributed within the casing of the apparatus to be cleaned and have cascaded therethrough, are collected at the bottom of the casing and conveyed back to the top of the apparatus by a cool air current usually induced by a suction fan. This air current partially reconditions the particles by bursting off deposits therefrom. Above the apparatus to be cleaned is a cyclone separator into which the pellets and the burst-off deposits accompanying the same are introduced and the pellets separated from the deposits and re-introduced into the apparatus to be cleaned while the conveying fluid is drawn off from the cyclone.

Usually the cleaning period is rather brief, that is, the period during which the shot pellets flow through the apparatus to be cleaned. In the interval of the cleaning periods, there is no flow of cleaning pellets in either direction. Since the efficiency of the cleaning action is dependent upon a certain intensity of the rain or the flow of pellets impinging against the heating surfaces, the fan means and conduits which recycle the pellets must be so dimensioned as to warrant the maintenance of a sufficient rate of flow of pellets back to the top of the apparatus to be cleaned during the cleaning period. Consequently, it is necessary to use powerful machinery during the short cleaning period interval to ensure the proper flow of pellets in the complete cycle.

Additionally, when the heating surfaces to be cleaned are of large dimensions, a plurality of complete cleaning units each having its own pellet distributor, circulating system and fan means, have to be employed to ensure satisfactory cleaning over the complete extent of the heating surfaces to be cleaned. It will, therefore, be appreciated that a complete cleaning system for a large

apparatus such as a large boiler or heat exchanger will entail operation with a high rate of flow of the cleaning pellets and the necessity for a plurality of distributor devices, fan means and the like, will require a high monetary investment and also the utilization of high powered machinery for the operation of the complete system.

Accordingly, the present invention has for an object to provide a method for cleaning gas-swept heating surfaces of heat exchangers and the like of economical initial cost and operation regardless of the dimensions of the heating surfaces to be cleaned.

Additionally, this invention has for an object to provide a method for cleaning gas-swept heating surfaces in which solid cleaning particles, such as shot pellets, are introduced through the top of the apparatus to be cleaned and above the heating surfaces therein are distributed throughout the cross-sectional area of the apparatus so that the the particles impact or impinge and ricochet against the surfaces to be cleaned, cascade through the apparatus, and return to the starting point above the apparatus for recycling through the apparatus in which the conveyance or return of particles to the starting position above the apparatus is effected over a duration of time considerably longer than the time duration of the actual cleaning period.

As a specific object, this invention provides a method in which the cleaning particles are distributed within and passed through the apparatus to be cleaned during short cleaning periods while the return of particles to the source of supply is at a continuous rate.

Following the teachings of the present invention in the cleaning of gas-swept surfaces of heat exchange apparatus by the cascading of solid cleaning particles such as shot pellets through the apparatus from top to bottom and recycling the pellets, the bulk of the cleaning pellets necessary to sustain an intense bombardment against the heating surfaces are conveyed from the bottom of the heat exchange apparatus back to the source of supply of pellets at a much lower rate than the rate at which the pellets drop against the heating surfaces during actual cleaning periods. Consequently, the fan means and the conduits necessary for conveying the pellets back to the source of supply are reduced as regards their dimensions and in some instances as regards the number of such units. Therefore, a substantial saving in dimensions, materials and investment costs is effected and with the lowered operating power factor and the continuous or extended operation of the return phase of the cycle, the load caused by operating the fan means will be greatly reduced.

It is a further particular object to provide compact apparatus which will accomplish the aforegoing extended return phase of the cleaning cycle.

Further and more specific objects will be apparent from the accompanying drawings, in which:

Figure 1 is a diagrammatic front elevational view of the heat exchange apparatus embodying the cleaning system of the present invention, and

Figure 2, is a diagrammatic, side elevational view of the apparatus illustrated in Figure 1.

In the drawings, similar parts are identified with the same reference numerals for the purposes of comparison. In the figures, the reference numeral 10 denotes a heat interchanging apparatus associated with a boiler plant including a casing embodying side walls and a top wall. An upper gas inlet communicates with the casing through a side wall thereof at an area adjacent the top wall and plural lower gas outlets communicate with each casing adjacent the lower extremity thereof. Within the casings are arranged, as indicated in my prior patents and application, tube means constituting the heat exchange surfaces. The tube means are not illustrated in this application since

they form no part of the present invention merely constituting the surfaces to be cleaned. In the system embodied in my prior patents and application, the heating surfaces are kept clean and free of dust deposits and adherent coatings by means of cleaning units each including a cyclone separator, the lower outlet of which communicates through bifurcated ducts or distributing tubes that pass through the top of the casing and terminate above the heating surfaces to be cleaned. Beneath the lower end of the distributing tubes are deflection members as embodied in my prior application Serial No. 320,333. It follows that the cleaning pellets passing through the tubes strike the deflection members and are distributed throughout the cross-sectional area of the casing.

A conveying conduit communicates with each cyclone separator and extends from the separating means that is disposed beneath the casing. The pellets pass from the heating systems within the casing downwardly into pockets at the lower end of the casing and pass into separating means where soot aggregates are separated from the pellets before the same are fed into the conveying conduit. This conduit has an open intake end and the outlet of the cyclone communicates with a suction conduit connected to a suction fan. It is clear that, in these prior embodiments with continuous operation during the relatively short cleaning period, high power factors and large conduit dimensions are necessary to attain an effective return rate of pellets from the separator means back to the cyclone separator for re-introduction into the casing.

By comparison with the aforedescribed installation, the one illustrated in Figures 1 and 2 is provided with a single cyclone separator 11' of greater capacity than the cyclone of the prior installation. From this cyclone 11' a plurality of distributing tubes 12' extend downward and pass through the top of the casing and as shown in Figure 2 deflection members 13 are disposed beneath the outlet ends of each tube 12'. At the bottom of the casing, the pockets 17', only two of which are used in comparision with the three embodied in the prior referred to arrangements, receive the pellets and feed them to the separating means 18 from whence they are fed or injected into the conduit 14'. This conduit has an open end to establish an air current therethrough and leads to the separator 11'. The outlet of the separator 11' feeds to a suction conduit 15' communicating with suction fan or pump means 16, the capacity of which may be equal to or even less than the capacity of the fan 16 embodied in the installation referred to above. The cleaning operation in those installations, that is the complete cycle, is continued during the cleaning intervals. This means that a comparatively very high or great volume of pellets is circulated during any given length of time while actual cleaning is occurring. During the intervals between the cleaning periods, there will be no conveyance or recycling of pellets. In the arrangement embodied in Figures 1 and 2 the suction fan 16 may operate continuously or in any case over extended periods of time so that the entire volume of cleaning particles or pellets that accumulate in pockets 17' after a cleaning period are progressively conveyed back to the cyclone separator 11'. When actual cleaning is to occur a valve member that is mounted beneath the bottom cyclone outlet, which valve is not shown in the drawings, is open and a bulk of cleaning pellets may distribute progresisvely against the deflection members 13 and subsequently against the heating surfaces. The cleaning action will be equal to or of greater intensity than that in the prior installations and the power consuming return phase of the cycle will be extended over much greater duration of time and thus a fan means with a lower output can be utilized. Since only one large cyclone separator, one fan and fewer conduits are needed in following this method, the investment costs are substantially reduced.

As an example of the effectiveness of the present invention, it is pointed out that in an instance where the heating surfaces to be cleaned have a total area of 50 m.^{2} and the height to which the pellets must be returned is 25 m. and if the heating plant is a coal-fired boiler, an intensity of 200 kgs. pellets per m.^{2} per hour may be adequate. It thus follows that a capacity of 10,000 kgs. pellets per hour is required of the fans. If each fan can convey 2700 kgs. pellets per hour, then four fans are required and they can thus convey 10,800 kgs. per hour. This factor is involved in a cleaning period which extends for one hour and in which the pellets are continuously returned to the top of the apparatus.

In carrying out the present invention, the cleaning period will still be an hour but there will be a seven-hour interval between cleaning periods. In this instance a single fan with a capacity of 2700 kgs. per hour will convey 18,900 kgs. of pellets in this seven-hour period from the enlarged pocket area at the bottom to the enlarged cyclone at the top. If these 18,900 kgs. of pellets are released during the hour cleaning period a more intense bombardment of the cleaning surfaces is attained than in the instance where the four fans which operate only during the actual cleaning period but only have a total capacity to convey 10,800 kgs. of pellets.

It is therefore clear that the present invention embodies the controlled feeding through the valve, not shown, of the pellets and the introduction and distribution of pellets into the casing of the apparatus to be cleaned so that the pellets cascade therethrough to clean the heating surfaces, the collection of the pellets beneath the flue gas outlet of the casing and the return of the pellets to the source of supply over an extended period of time and at a reduced rate as compared with the rate of travel through the casing during the cleaning operation.

Thus and in accordance with the example given above, a cleaning period is of one-hour duration while the return period is of seven-hour duration. Therefore, the cycle between start of cleaning and the re-accumulation of the supply of pellets for the next cleaning is eight hours.

Therefore in accordance with this invention, I have provided a method for cleaning gas-swept heating surfaces of heat interchanging apparatus during the operation thereof. The apparatus is of the type embodying walls and inlets and outlets for the gas and means that provide heat exchange surfaces within the walls. The method consists essentially of controllably feeding cleaning particles, preferably shot pellets, from an accumulator position above the apparatus and introducing and simultaneously spreading the pellets within the walls of the casing at a predetermined rate and at a level above the surfaces to be cleaned throughout substantially the cross-sectional area comprised between the walls so that the pellets fall by gravity and ricochet against the surfaces to be cleaned to pick up material accumulated thereon and dislodge particles of material therefrom. The pellets are collected beneath the surfaces that have now been cleaned and also beneath the gas outlet and are then entrained in a confined gaseous current and progressively returned to the accumulator at a rate substantially slower than the rate of passage through the apparatus so that the cleaning particles or pellets accumulate at the source for use during a subsequent cleaning operation. Additionally, during the return to the source, the material that is accumulated on the pellets during passage through the apparatus and any material accompanying the pellets such as those deposits burst off from the pellets under the action of the confined gaseous current when the same is cool air, are separated from the pellets before they are accumulated and in readiness for a subsequent cleaning operation.

Thus the accumulator can preferably constitute a cyclone separator having substantial capacity so that it constitutes a combined separator and accumulator and the source of supply for the particles or pellets. Beneath the separator is a distributing means that distributes pellets through a plurality of tubes each communicating with

a portion of the apparatus to be cleaned through the top thereof and each terminating above the surfaces to be cleaned. Operatively associated with the lower end of each tube is a deflection member which deflects the pellets falling through the tube so that they are effectively distributed throughout substantially the cross-sectional area comprised between the walls of the apparatus. Beneath the heat interchanging apparatus, that is, connected thereto at a level below the flue gas outlet or outlets, are suitable collecting pockets which feed to separators that separate larger particles of material or dust from the pellets and which in turn also feed the pellets so that they are entrained in a confined stream of gaseous medium, preferably cool air, the air current being established by a suitable suction fan that communicates with the upper outlet of the cyclone separator so that the pellets are conveyed back to the cyclone separator and any material accompanying the same or burst off therefrom under the action of the cool air is separated in the separator and led off with the exhaust from the suction fan for any desired treatment which can comprise the recovering of useful components from the material dislodged from the heating surfaces within the apparatus.

What is claimed is:

1. A method of cleaning gas-swept heating surfaces of heat interchanging apparatus comprising feeding solid cleaning particles for a given period of time only from a source of supply above the apparatus and distributing the particles within the apparatus at a predetermined rate, above the surfaces to be cleaned and throughout substantially the cross-sectional area of the apparatus so that the particles cascade through the apparatus by gravity and impact and ricochet against the surfaces to be cleaned to pick up material accumulated thereon and to dislodge particles or material therefrom, separating at least most of the material from the particles, collecting the particles beneath the surfaces, entraining the particles in a confined gaseous current and returning the particles to the source for a period substantially in excess of the period of feed with the rate of return being substantially slower than the rate of passage through the apparatus so that cleaning particles accumulate at the source for use during a subsequent cleaning operation.

2. A method of cleaning the gas-swept heating surfaces of heat interchanging apparatus which apparatus is of the type embodying walls defining a casing and means providing heat exchange surfaces within the casing and gas inlet and outlet means communicating with the casing,

comprising feeding a supply of metallic cleaning particles from a source of supply above the apparatus and introducing and simultaneously spreading the cleaning particles within the apparatus at a level above the surfaces to be cleaned and throughout substantially the cross-sectional area thereof so that the particles cascade through the apparatus and impact and ricochet against the surfaces to be cleaned to pick up material accumulated thereon and to dislodge material therefrom with the particles passing through the apparatus at a rate and in quantity governed by gravity and the duration of the feeding period, ceasing the feed of particles, separating at least part of the material from the particles, collecting the particles from beneath the surfaces, entraining the particles in a confined gaseous current with the rate of entraining being less than the rate of passage through the apparatus and returning the cleaning particles to the source at a rate consistent with the rate of entrainment and substantially slower than the rate of passage through the apparatus whereby the cleaning particles accumulate at the source for use during a subsequent cleaning operation.

3. In the method of cleaning gas-swept surfaces of heat interchanging apparatus of the type which includes the steps of feeding shot pellets from the source of supply located above the apparatus to be cleaned and distributing the pellets throughout substantially the cross-sectional area of the apparatus at a level above the surfaces so that the pellets cascade through the apparatus and impinge and ricochet against the surfaces to pick up material accumulated thereon and to dislodge material therefrom so as to clean the same and in which method at least the pellets are collected at a level beneath the surfaces and returned to the source of supply, the improvements comprising feeding pellets so that they pass through the apparatus for a predetermined period of time, ceasing the feed of pellets, returning the pellets to the source during and after the period of feed for a period of time substantially in excess of the period of feed and at a rate substantially lower than the rate of passage through the apparatus whereby the pellets accumulate at the source for use during a subsequent cleaning period so that with each period of feed being considerably shorter than the preceding period of return an intensified cleaning action ensues.

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