Oct. 1, 1968 A. PARKIN 3,403,642

EMERGENCY SHUTDOWN OPERATION OF RECOVERY BOILERS

Filed April 9, 1965 4 Sheets-Sheet 1

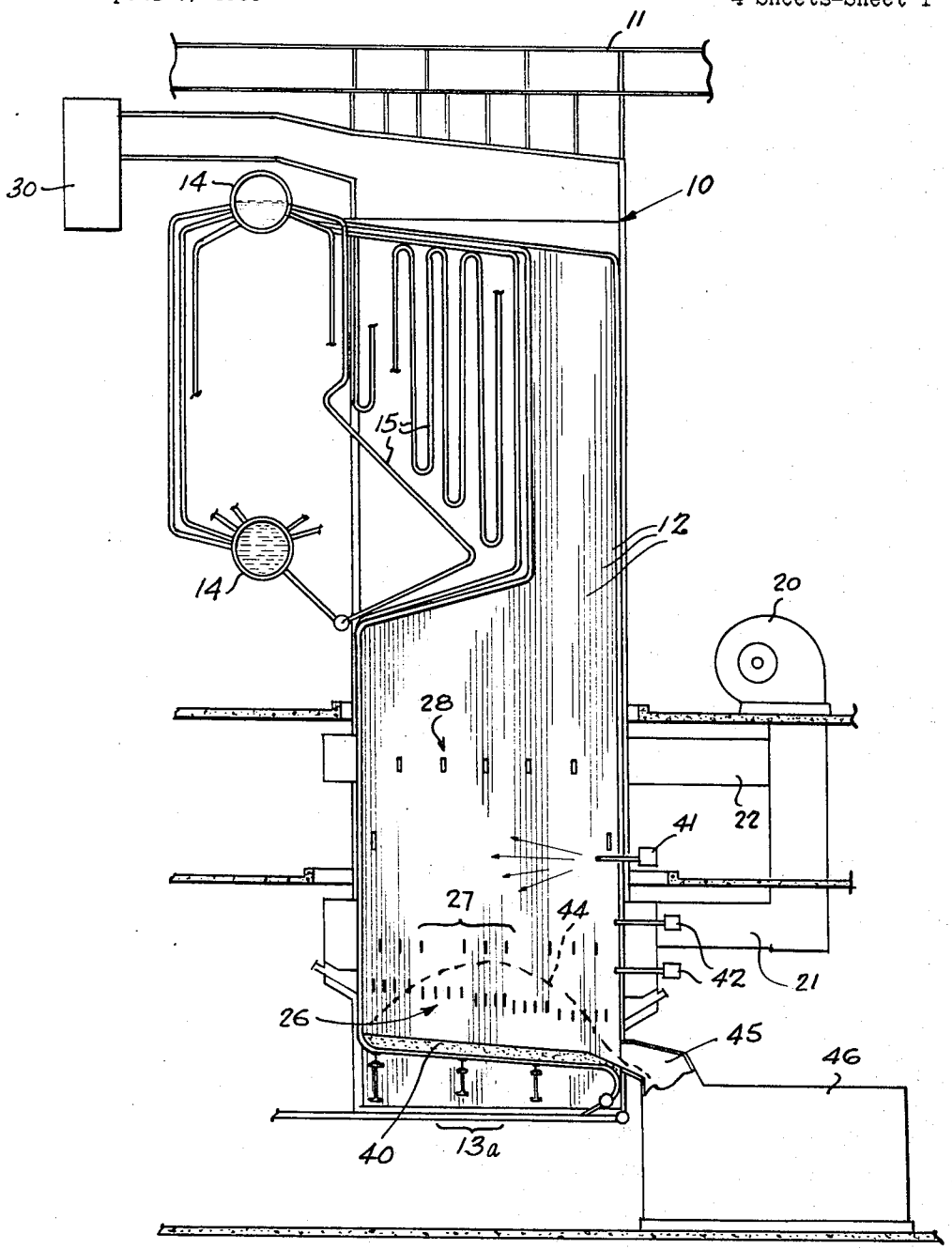


FIG. 1.
PRIOR ART

INVENTOR
ALVIN PARKIN
By Emery L. Groff Atty

Oct. 1, 1968 A. PARKIN 3,403,642

EMERGENCY SHUTDOWN OPERATION OF RECOVERY BOILERS

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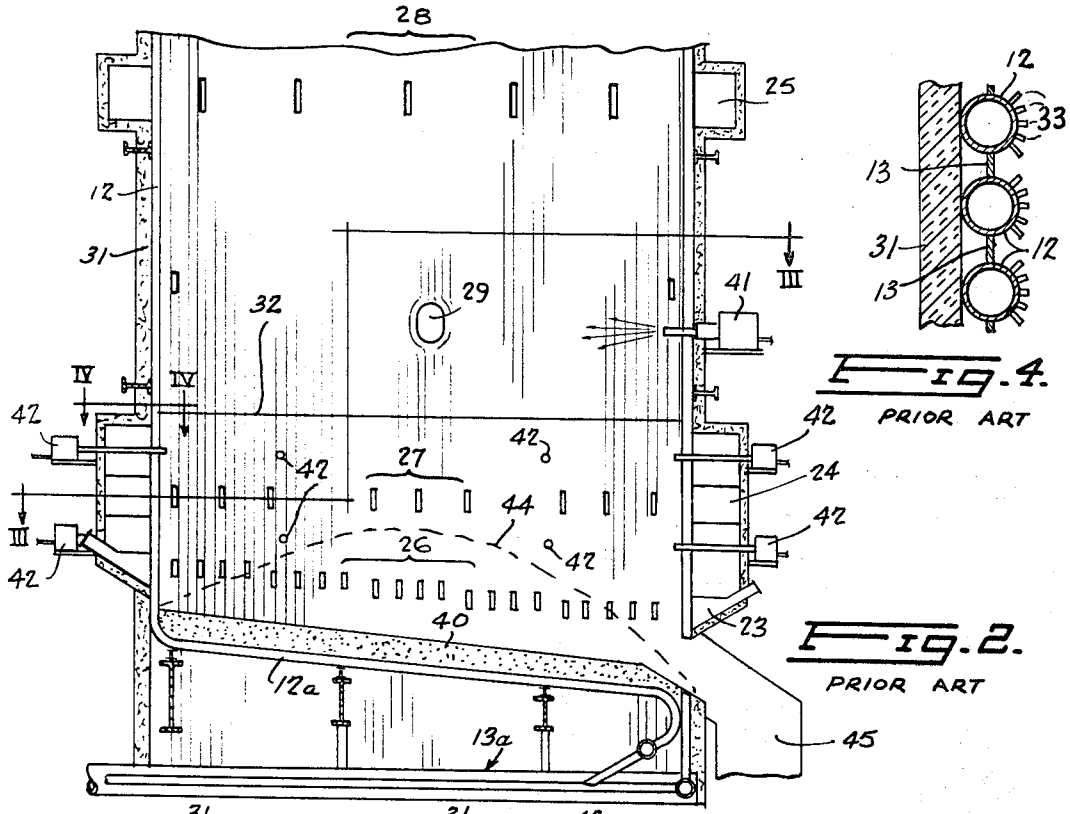


FIG. 4.
PRIOR ART

FIG. 2.
PRIOR ART

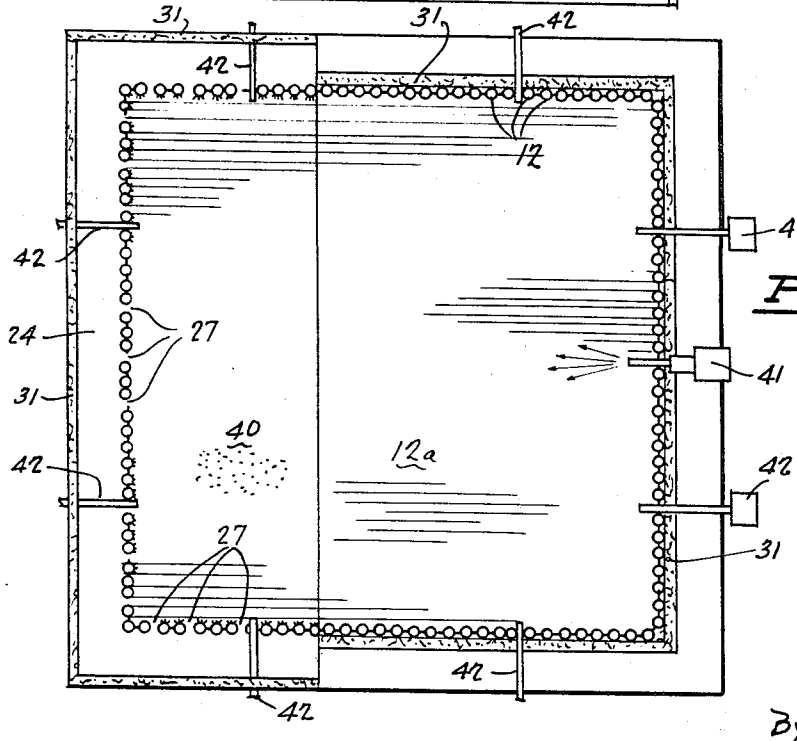


FIG. 3.
PRIOR ART

INVENTOR
ALVIN PARKIN
By Emory L. Bolton Jr.
Atty

Oct. 1, 1968 A. PARKIN 3,403,642

EMERGENCY SHUTDOWN OPERATION OF RECOVERY BOILERS

Filed April 9, 1965 4 Sheets-Sheet 3

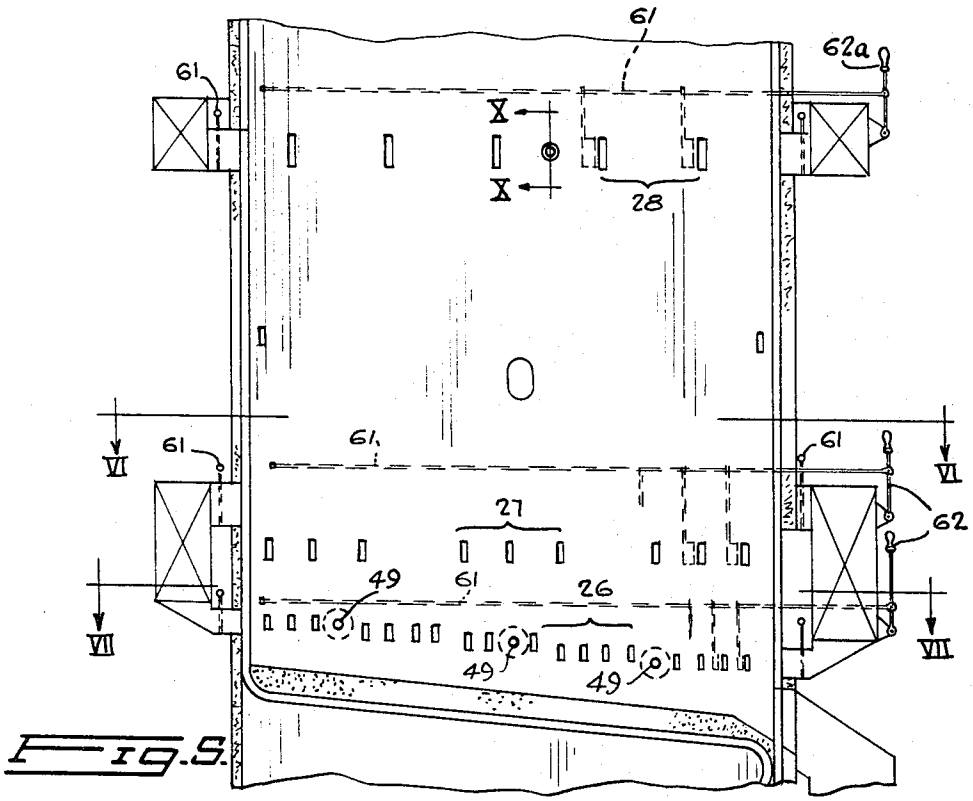


Fig. 5.

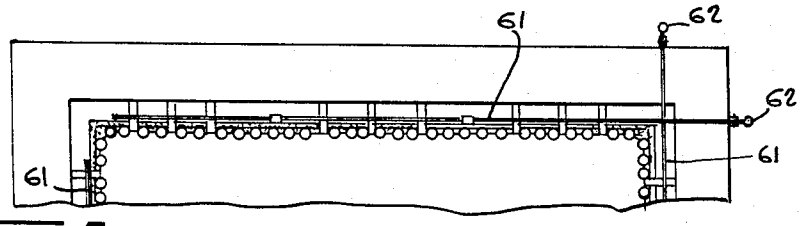


Fig. 6.

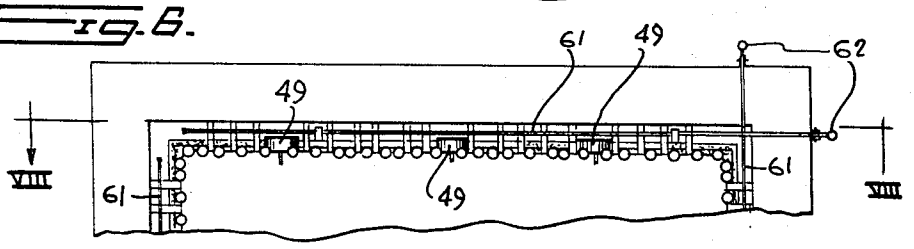


Fig. 7.

INVENTOR
ALVIN PARKIN
By Emory L. Groff Jr. Atty

Oct. 1, 1968 A. PARKIN 3,403,642

EMERGENCY SHUTDOWN OPERATION OF RECOVERY BOILERS

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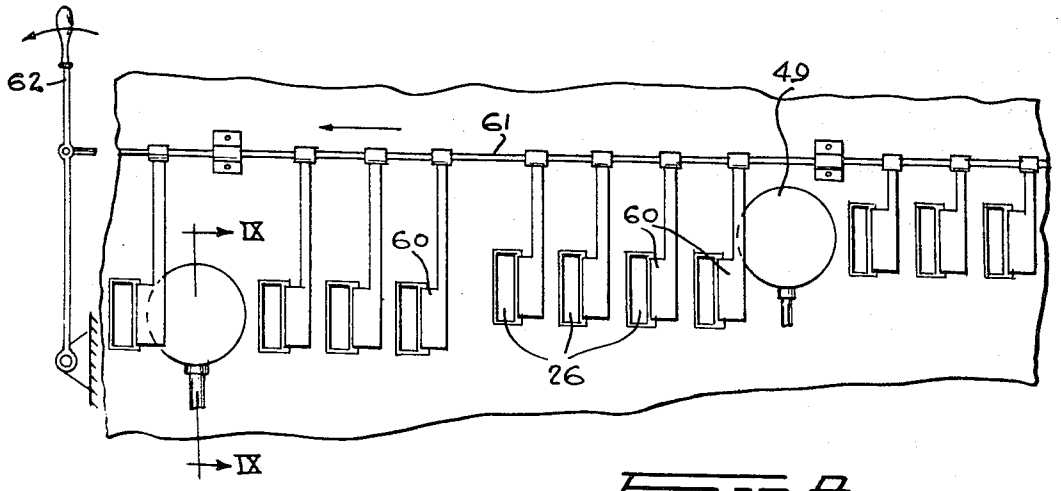


Fig. 8.

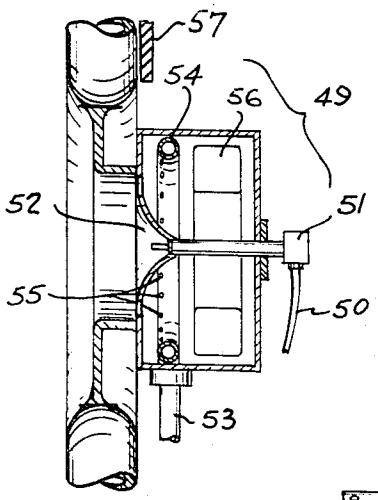


Fig. 9.

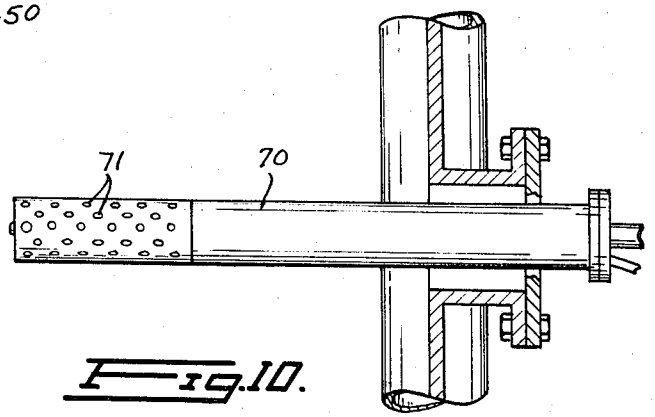


Fig. 10.

INVENTOR
ALVIN PARKIN
By Emory L. Groff Atty

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3,403,642

EMERGENCY SHUTDOWN OPERATION OF RECOVERY BOILERS

Alvin Parkin, R.R. 2, Campbell River, British Columbia, Canada

Filed Apr. 9, 1965, Ser. No. 446,937
Claims priority, application Canada, Aug. 7, 1964, 908,954
6 Claims. (Cl. 110—7)

This invention relates to improvements in the manner of construction and method of operation of a recovery boiler of the type employed for example in the so-called kraft sulphate pulp process in the paper industry.

More specifically, the invention is directed towards a recovery boiler which constitutes a black liquor recovery unit. In the production of pulp, wood chips are cooked in digestors with a "white" liquor of which the active chemicals are sodium hydroxide and sodium sulphide. This action separates the lignin from the cellulose of the wood, the lignin being the binder material that holds the cellulose fibres together. The cellulose, upon separation from the lignin, provides the pulp for the manufacture of paper.

The residual black liquor containing the spent chemicals and the dissolved lignin is collected, because it is possible to recover the chemicals from this liquor by burning off the lignin. Such recovery of the chemicals is necessary, in order to make the process economically feasible, and this is the prime purpose of a recovery boiler. However, a great deal of heat is generated in the burning process and it has become conventional to convert this heat to steam for general use in the plant.

In order to provide a fuller understanding of the typical structure of this type of boiler, which is now extensively used by the industry, reference will now be made to the accompanying drawings, for which purpose a list of such drawings is first set out.

FIGURE 1 shows the main parts of a recovery boiler of the type referred to above, at least those parts relevant to the present considerations;

FIGURE 2 is a larger fragmentary view of the lower part of the boiler shown in FIGURE 1, taken in central section;

FIGURE 3 is a section on the line III—III in FIGURE 2; and

FIGURE 4 is a large scale fragmentary section on the line IV—IV in FIGURE 2.

The drawings so far listed represent a conventional boiler and hence the prior art to the present invention.

The structural aspects of the present invention are illustrated diagrammatically and by way of example only in FIGURES 5 to 10, details of which are as follows.

FIGURE 5 is a view corresponding to FIGURE 2 showing modifications of the structure of the boiler in accordance with the present invention;

FIGURE 6 is a fragmentary section on the line VI—VI in FIGURE 5;

FIGURE 7 is a fragmentary section on the line VII—VII in FIGURE 5;

FIGURE 8 is a central sectional view of a lower portion of the modified boiler;

FIGURE 9 is a view of a typical burner for use in the arrangement of FIGURE 8; and

FIGURE 10 is an enlarged view taken on the line X—X in FIGURE 5.

The conventional boiler construction illustrated in FIGURES 1 to 4 comprises essentially a large, rectangular, vertically elongated enclosure **10** hung from steel beams **11** beneath the roof of the building. The enclosure is formed by means of walls composed of an array of vertically disposed tubes **12** (seen in detail in FIGURE 4)

joined together by webs **13**. In addition to surrounding the interior of the boiler in this manner, some of the tubes **12** extend at **12***a* to form a sloping floor for the boiler. In operation the tubes contain water, and they are interconnected by headers shown only generally at **13***a* beneath the floor of the boiler and also communicates with water storage tanks **14** and superheating and screen tubes **15** arranged in the upper part of the enclosure. The tubes **15** which are provided in addition to the tubes **12** that form the bounding walls of the boiler are located generally above the central area where combustion takes place. Since the manner of arrangement and operation of the water system of the boiler is entirely conventional and has not been modified by the present invention, no further description is believed necessary.

A forced draft fan **20** is provided to blow air through ducts **21** and **22** which in turn lead to ducts **23**, **24** and **25** which surround the four walls of the boiler at different levels. As best seen in FIGURE 2, these ducts serve to supply a draft of air to a series of primary air ports **26**, a series of secondary air ports **27** above the primary air ports **26**, and a series of tertiary air ports **28** arranged at a still higher elevation in the boiler. In practice, these ports are formed by omitting short lengths of web **13** between the tubes **12** and bending short sections of such tubes towards each other to form openings communicating with the interior of the boiler. Apart from an access port **29**, which is used when the boiler is shut down and is closed during operation, the air ports **26**, **27** and **28** provide the only means of access for air to the interior of the boiler enclosure. An induced draft fan is also provided, and has been illustrated diagrammatically at **30** in FIGURE 1. In practice the installation is normally more complex than has been shown, including a cyclone evaporator where the flue gases are brought into contact with the black liquor to increase the solids content thereof. Again, these components are in no way modified by the present invention and a detailed description of them would be irrelevant for the purposes of the present specification.

The wall tubes **12** are surrounded on the outside by a layer of thermal insulation **31** and, below the line **32** which is referred to as the "full stud line," the inside faces of the tubes **12** are provided with projecting studs **33** which serve at least temporarily to retain black liquor which is sprayed onto them, to cake and ultimately drop down onto the char bed.

Prior to the boiler being placed in service a fire bed **40** is formed above the lower tubes **12***a*, this floor being made of chrome dust which is hammered down into hard, brick-like form.

A spray **41** for the black liquor is provided in one of the walls of the boiler. A typical such black liquor spray is arranged to oscillate and to spray the black liquor all around the inside of the boiler, down towards the floor and towards all parts of the wall for the liquor to adhere at least in part to the walls, and more particularly to the studs **33** on the lower portions of the tubes **12**. In addition to the black liquor spray **41**, of which there may be more than one, a series of oil burners **42** are arranged around the sides of the boiler. Typically, a few such burners will be provided at a level above the primary ports **26**, and some will be located above the secondary ports **27**.

When the boiler is started up, black liquor is sprayed onto the fire bed **40** from the spray **41** and oil is sprayed in through the burners **42** and ignited by any suitable means. The burning oil causes combustion of the black liquor and, after operation for a short time, there builds up in the centre of the boiler enclosure a roughly conical heap of burning material which is represented diagrammatically in FIGURES 1 and 2 by the broken line **44**.

This heap of burning material is referred to as the char bed and will burn at a temperature typically somewhere within the range of 1200° to 1500° F., but sometimes in part as high as 1800° F. Once the fire has thus been thoroughly started, the oil burners are turned off and no further oil is normally applied to the boiler. Indeed the burners are normally withdrawn from the walls at this time. Combustion continues from the black liquor which continues to be supplied from the spray **41**. The char bed yields a liquor called smelt which contains the chemicals to be recovered, the lignin having provided the source of heat and being largely converted to gas. In addition to combustion of the lignin, the sodium sulphate in the black liquor combines with carbon to produce sodium sulphide, carbon monoxide and carbon dioxide. Sodium carbonate is also formed from the lignin. The smelt is drained off through a duct **45** for further treatment in a conventional manner in a hot water dissolving tank **46**.

The forced draft fan **20** and the induced draft fan **30** combine to maintain a continuous flow of air upwardly from the char bed through the boiler, thus maintaining and encouraging combustion at the char bed and removing the products of combustion which thus heat the superheating and screen tubes **15** in the upper part of the boiler, while the char bed itself mainly imparts its heat to the water in the wall tubes **12**.

The air supplied through the primary ports **26** is at a comparatively low pressure in order to promote a reducing atmosphere in the burning mass of char. The secondary ports **27** which are about 5 to 6 feet above the primary ports **26** have air supplied through them at a slightly higher pressure, in order to promote burning of combustible materials rising from the glowing mass of the char bed, while the air supplied to the tertiary ports **28** is at a still higher pressure, being designed to further and complete the combustion process.

As has been mentioned, the oil burners **42** are not permanently fixed in the unit. They are inserted through ports at approximately the level of the secondary ports **27**, as and when they are needed. Normally these burners **42** are only required for starting up the boiler, for operation under adverse operating conditions (as will be more specifically described below), and for burning down the char bed when shutting down the boiler. For shut down, the supply of black liquor is turned off and sufficient oil is supplied to ensure that the char bed is fully consumed. Typically, such a shut down operation takes from 4 to 6 hours.

When the boiler is operating normally, the char bed assumes the shape of an irregular heap the sides of which are approximately on a level with the primary ports **26**, while its high points are approximately on a level with the secondary ports **27**. Drying combustible material is continuously falling on top of this heap, as the organic material is burnt off. Such combustible material comes directly from the spray **41** and also falls from the side and back walls on which it has become partially dried and caked as it runs down the faces of the wall tubes **12**.

All the description of structure and operation which has so far been provided in this specification relates to conventional boiler construction and operation.

One of the principal difficulties in operating this type of boiler is the danger of explosion. In recent years several men have lost their lives or been seriously injured in pulp mill explosions, and extensive damage to plant has been incurred. The danger of explosion arises from leakage of water from the tubes some measure of which is virtually inevitable at some time or other. There are so many tubes, all subjected to rigorous temperature conditions, that, as a practical matter, it is impossible to operate for any length of time without tolerating a certain amount of water leakage. Serious leaks require immediate shut down of the boiler, but naturally it is desirable to keep the number of shut downs to a minimum. The operating time lost by a shut down is substantial and

this is particularly true in the case of an emergency shut down when no time had been available for first consuming the char bed. If the boiler is allowed to cool with the char bed unconsumed, its subsequent removal when cold is a lengthy, expensive and at times dangerous undertaking.

It therefore becomes necessary to accept the fact that operation with a certain degree of water leakage onto the char bed is economically essential. Procedures have been worked out and are in operation for minimizing the danger resulting from water leaks. Moreover, at any time when the danger appears to be becoming excessive there is immediately put into effect an emergency shut down procedure. Notwithstanding the use of the latter, a number of serious explosions have taken place in recent years and it has become apparent that reliance on the present emergency shut down procedures is insufficient for the protection of property and lives.

To explain the reason why water leakage can lead to an explosion, assume that a leak develops in one of the tubes **12** or **15** and that water falls down onto the hot char bed. The chemical reaction between water and the char bed and its smelt chemicals is complex, but for the present purposes, the important aspect of the reaction is that the falling water tends to form a local "black spot" on the char bed, that is an area of reduced temperature, and under these conditions the water and sodium sulphide react to form sodium sulphate and hydrogen. It is this hydrogen which becomes mixed with air above the char bed to form an explosive mixture.

Normal operating procedure calls for a pressure slightly below atmospheric in the vicinity of the char bed. In other words, the induced draft fan **30** is arranged together with the natural tendency of the hot gases to rise, to exceed in pressure drop the pressure gain from the forced draft fan **20**. This is the preferred mode of operation, but cannot always be maintained. Often the first indication that a water leak exists is a tendency for the pressure in the boiler in the vicinity of the char bed to rise slightly, such increased pressure being due to the generation of steam from the leaking water and the resulting excess of vapor in the boiler. There are, of course, other ways in which a leak may be detected, either by a drop of pressure in the water system itself or by visual or aural detection.

Present operating procedure provides that once the existance of a leak has been detected, the situation is carefully watched by the operating engineer and efforts are made to prevent the pressure at the char bed rising excessively. For example, the dampers on the forced draft fan **20** may be partly closed, to reduce the input of air to the lower end of the boiler. It is not uncommon for boilers of this type to continue to operate for weeks with one or more small leaks, until a routine maintenance shut down becomes due. However, as soon as a leak shows any tendency to become too large, the crew initiates the shut down procedure. Depending upon the seriousness of the leak, this may take the form of either the emergency or the normal shut down procedure. As already explained, the normal shut down procedure consists of turning off the supply of black liquor while returning the oil burners to the boiler to slowly burn away the char bed. The burners are adjusted to lower the boiler temperature gradually until it is safe to turn the burners off altogether and allow the assembly to cool down to atmospheric temperature.

The emergency shut down procedure as conventionally practiced is essentially designed to lower the temperature in the boiler as quickly as possible, in other words "to put the fire out" with all possible dispatch, while of course maintaining the boiler as far as possible in a condition that is least likely to lead to an explosion. The black liquor flow is stopped, and the forced draft air flow is controlled by dampers either to be reduced or more often turned off completely. At the discretion of the engineer the oil burners may be employed to a limited

extent at this stage in an effort to prevent the fire cooling down too quickly, especially at local areas. Also the black liquor line may be reopened for a minute or so in an effort to form an insulating blanket over the char bed. However, once the emergency shut down procedure has begun in earnest, no oil and no black liquor will normally be fed into the boiler and the forced draft damper will be fully closed, the basic aim being to cool down the char bed as soon as possible. In a short time the char bed will go completely black, the temperature already having begun to fall significantly. Even so, the whole cooling down process takes several hours. Meanwhile, the induced draft fan is kept running in an endeavour to remove as much as possible of the potentially explosive gases that can be expected to be formed by the interaction of water with the still hot char bed. Indeed it is at this time, i.e. while cooling down from normal operating temperature, that the conditions are most conducive to the formation of substantial quantities of hydrogen. In a recent accident, it was found that the induced draft fan had lost power at this stage, because of falling steam pressure.

Not only may black liquor be sprayed on the bed at this time to provide a relatively cool insulating blanket over the molten char, but it has even been suggested that steam be injected into the boiler at this time to attempt to smother the fire as quickly as possible. This basic concept of trying to lower the temperature as quickly as possible is inherent in all presently practised versions of the emergency shut down procedure, some details of which may vary between various installations and in the light of circumstances, at the direction of the various engineers in charge.

Notwithstanding these precautions, there have been a number of recent instances when such emergency procedure have proved insufficient. Explosive combinations of gases, especially hydrogen and oxygen have built up in the boiler while the fire was still hot enough to ignite them. The resulting explosions have been costly both in lives and material.

The basic concept underlying the present invention is that any attempt to smother the fire under the emergency condition of excessive water leakage is essentially misguided, and that, conversely, the procedure which is far safer is to take steps to increase the temperature of the char bed in order to consume this bed as quickly as possible while keeping the same at a temperature high enough that either no significant amount of hydrogen is produced or any hydrogen that is generated is burnt, before it has been permitted to accumulate. For example, the temperature of a typical portion of the char bed should be raised to at least 2000° F. and preferably more to the region of 2400° F.

The preferred manner of achieving this end will now be described in relation to FIGURES 5 to 10, in which connection it is to be understood that the apparatus and methods now to be described are provided merely as example of ways in which the foregoing broad concept of the invention may be practiced. Alternatives within this broad concept also form part of the present invention, even though some of the structure employed may differ in form.

In order to achieve an effective increase in the operating temperature of the char bed, even in the face of the leaking water which tends to cool the char bed, it is preferable to substantially prevent any excess of air entering the boiler (through the primary, secondary and tertiary ports) and to provide burners for generating intensely hot flames and for supplying oxygen to the char bed, these burners being located adjacent the boiler floor structure in order to direct the hot flames and oxygen directly at the char bed and particularly at the lower part thereof below and at the level of the primary ports. By reason of the intensely hot flames and oxygen directed against the char bed the same is quickly consumed (no additional black liquor being supplied) in a much quicker time than is normal with the presently practiced routine or emergency shut down procedures.

FIGURE 9 illustrates generally a typical form of burner that could be used for this purpose. The burner itself is conventional, but its application at this particular location in a recovery boiler is novel. The burner consists of an oil supply line **50** which feeds to an atomizer mechanism **51** by which the oil fuel is jetted from head **52** towards the char bed. Oxygen is supplied through pipe **53** to an annular header **54** from which it issues at orifices **55** to ensure an oxygen-enriched atmosphere in the vicinity of the char bed. Louvres **56** can be adjusted to admit some air, if desired, or to exclude all air from the device.

According to the preferred form of the present invention the boiler structure is modified to introduce a number of such burners **49** into the walls of the enclosure at approximately the level of the primary ports. Typical location of these burners **49** is indicated in FIGURES 5, 7 and 8, in which views the burners themselves are merely shown diagrammatically. FIGURE 8 also shows (purely symbolically and by way of example) that each of the primary ports **26** is provided with a movable damper **60** by which such port can be fully closed. Simultaneous operation of the dampers **60** is provided for by a mechanism such as the rod **61** and control lever **62**. Similar mechanisms are fitted to the secondary and tertiary ports. FIGURE 5 indicates levers **62** are controlling louvres on the primary and secondary ports. A similar lever **62*a*** is provided for controlling closure of the tertiary ports **28**. It will be appreciated that the specific construction of these parts may differ widely from installation to installation, especially having regard to the particular problems presented at each installation by the location of other parts. The issue of importance from the point of view of the present invention is that each of the air admission ports should be capable of being closed when the burners **49** are in operation.

It is anticipated that the burners **49** would normally form part of the permanent structure of the boiler, rather than being constructed for insertion and withdrawal in the manner of the conventional oil burners **42** (which may still be employed for normal operation). On the other hand, if preferred in any particular installation, the burners **49** may be made capable of being withdrawn from the boiler, with appropriate provision then being made for closing the ports through which they operate, for example a downwardly slidable damper **57** as shown in FIGURE 9.

The additional apparatus provided by the present invention is designed primarily for use during emergency conditions, and specifically to enable a new and improved emergency shut down procedure to be employed. Alternatively, the burners **49** may entirely replace the conventional burners **42** and be used to perform the function of the burners **42** during the firing up process, in which case the additional apparatus will be used both during normal and during emergency operating conditions. Nevertheless, its prime purpose is to make possible the new and improved shut down procedure which consists essentially of increasing the temperature of the char bed, rather than decreasing it, as has been the practice heretofore. This new procedure enables the char bed to be consumed in a relatively short time (typically half an hour) under conditions which are not conducive to the formation of explosive gases in any dangerous quantity. Once the char bed has been consumed the burners **49** are shut down.

When a boiler is operated under this new emergency shut down procedure, oil is supplied under pressure in each of the lines **50** and oxygen in each of the lines **53**. It is important to stress that the particular form of burner shown in FIGURE 9 is merely illustrated by way of example. Numerous suitable burners are commercially available, the important consideration being that an extremely hot consuming flame be generated, a result best

achieved by the use of added oxygen supplied from a convenient source, plus the necessary fuel for the burner which may be oil, or could be gas. The supplying of oxygen to these burners makes them independent of the environmental conditions in the boiler. There will always be a flame, and will not be extinguished by water. Such burners throw a short, hot flame and are arranged low down in the boiler (at or adjacent the level of the primary ports) with their flames projected directly towards the centre of the boiler enclosure to consume the char bed as quickly as possible. As the char bed is consumed the burners may be adjusted to increase the flame length and project further into the centre of the char bed. Any excess air entering the boiler is kept to a minimum by shutting (or, if preferred in a particular case, nearly shutting) all the dampers **60** on the normally open primary, secondary and tertiary ports, these latter being capable of normal operation during normal operation of the boiler simply by fully opening the dampers **60**. If preferred some of the dampers can be separately controlled.

The induced draft fan **30** is run at full speed during the emergency shut down procedure, for which purpose such fan should be powered from a source independent of the steam pressure available in the boiler at this time. The force draft fan **20** is normally shut off, although its condition will not normally be critical, sinc the air admission ports will be closed. In the event that the engineer in charge decides to admit a small quantity of air to the boiler through the ports, it may be desirable to maintain the force draft fan running at low speed. It will be appreciated that the degree of severity of the leak and the pressure conditions resulting therefrom may call for variations in the details of the emergency shut down procedure at the discretion of the engineer in charge. For example, it might be that in a particular boiler it is found better merely to close the primary and secondary ports and leave open or partly open the tertiary air ports. Nevertheless, it will be desirable to provide some dampers or other means for closing at least the primary air ports and preferably also the secondary and tertiary air ports, so that the engineer in charge has full control over any small amount of excess air that he may decide to permit to enter the boiler. The reason for possibly permitting a certain amount of air to enter the boiler (for example through the burner louvres **56**) is that it is desired at all times during the new emergency shut down procedure to maintain a steady current of gases travelling upwardly in the boiler (principally induced by the induction fan **30**) to remove from the interior of the boiler any small amounts of potentially explosive gases that may be generated and to prevent their accumulating.

As a further and preferred feature of the present invention, it is convenient to insert one or more ignitors **70** to project into the boiler, preferably at or in the vicinity of the level of the tertiary ports **28**. The location of an ignitor is shown in FIGURE 5, and a larger scale view of the device itself is shown in FIGURE 10. Like the burners **49**, ignitors of this type are standard items available commercially. Most employ gas and have suitable provision for igniting the gas and projecting the flame through orifices **71** at the end of the ignitor **70** which projects into the interior of the boiler enclosure. In addition to the gas fuel each ignitor is supplied with oxygen so that it cannot be extinguished by water or by lack of oxygen. Thus even under the most adverse conditions there will always be a flame present to burn off any inflammable gases. The fuel gas used in the ignitors should be capable of burning regardless of the ambient temperature. The ignitor or ignitors thus ignite any combustible gas that may have risen from the char bed and thus further discourage the accumulation of any such gases in explosive quantities. Alternatively, or additionally, one or more further such ignitors may be inserted into the boiler at the level of the black liquor spray.

If desired, such ignitors once provided in accordance with the preferred form of the present invention may be used at all times, not only during the new emergency shut down procedure. For example they could be used during the firing up procedure, during normal operation, or during the normal shut down procedure.

I claim:

1. In the operation of a recovery boiler of the type employed in the sulphate pulp process, normal operation of said boiler comprising forming a burning char bed in a vertically extending closure having air admission ports, including a draft flowing upwardly in said enclosure to draw gases out of an upper part thereof and feeding black liquor onto said char bed to maintain the same at an elevated temperature; a method of effecting emergency shut-down including performing substantially simultaneously the steps of:

(a) elevating the temperature of substantially the whole of the surface of said char bed to a temperature substantially above said elevated temperature,

(b) halting feeding of the black liquor to allow the char bed to be consumed without replacement,

(c) maintaining an oxygen-enriched atmosphere in the vicinity of said char bed to encourage the full combustion thereof and to discourage liberation of combustible gases, and

(d) maintaining said upwardly flowing draft.

2. A method according to claim **1** wherein said char bed surface is elevated to a temperature of approximately 2,400° F.

3. A method according to claim **1** wherein oxygen is supplied to said char bed during said emergency shut down.

4. In the operation of a recovery boiler of the type employed in the sulphate pulp process, the normal operation of said boiler comprising forming a burning char bed at a temperature within the range of 1200° to 1800° F., and maintaining said burning char bed by feeding black liquor thereto, while confining said char bed in an enclosure, including inducing in said enclosure a draft of gases flowing upwardly from the char bed to be exhausted from an upper part of said enclosure; a method of effecting emergency shut down including performing substantially simultaneously the steps of:

(a) elevating the temperature of substantially the whole of the surface of said char bed to at least 2000° F.,

(b) halting feeding of the black liquor to allow the char bed to be consumed without replacement,

(c) maintaining an oxygen-enriched atmosphere in the vicinity of said char bed to encourage the full combustion thereof and to discourage liberation of combustible gases,

(d) and maintaining said upwardly flowing draft.

5. The method of claim **4**, wherein said oxygen-enriched atmosphere is generated by supplying oxygen to said char bed while restricting the flow of air thereto.

6. The method of claim **4**, including providing igniting means in said draft above the char bed to ignite any combustible gases therein.

References Cited

UNITED STATES PATENTS

1,137,780	5/1915	Moore	23—48
2,416,462	2/1917	Wilcoxson	23—277
2,550,670	5/1951	Dalin	23—262

JAMES H. TAYMAN, JR., *Primary Examiner.*