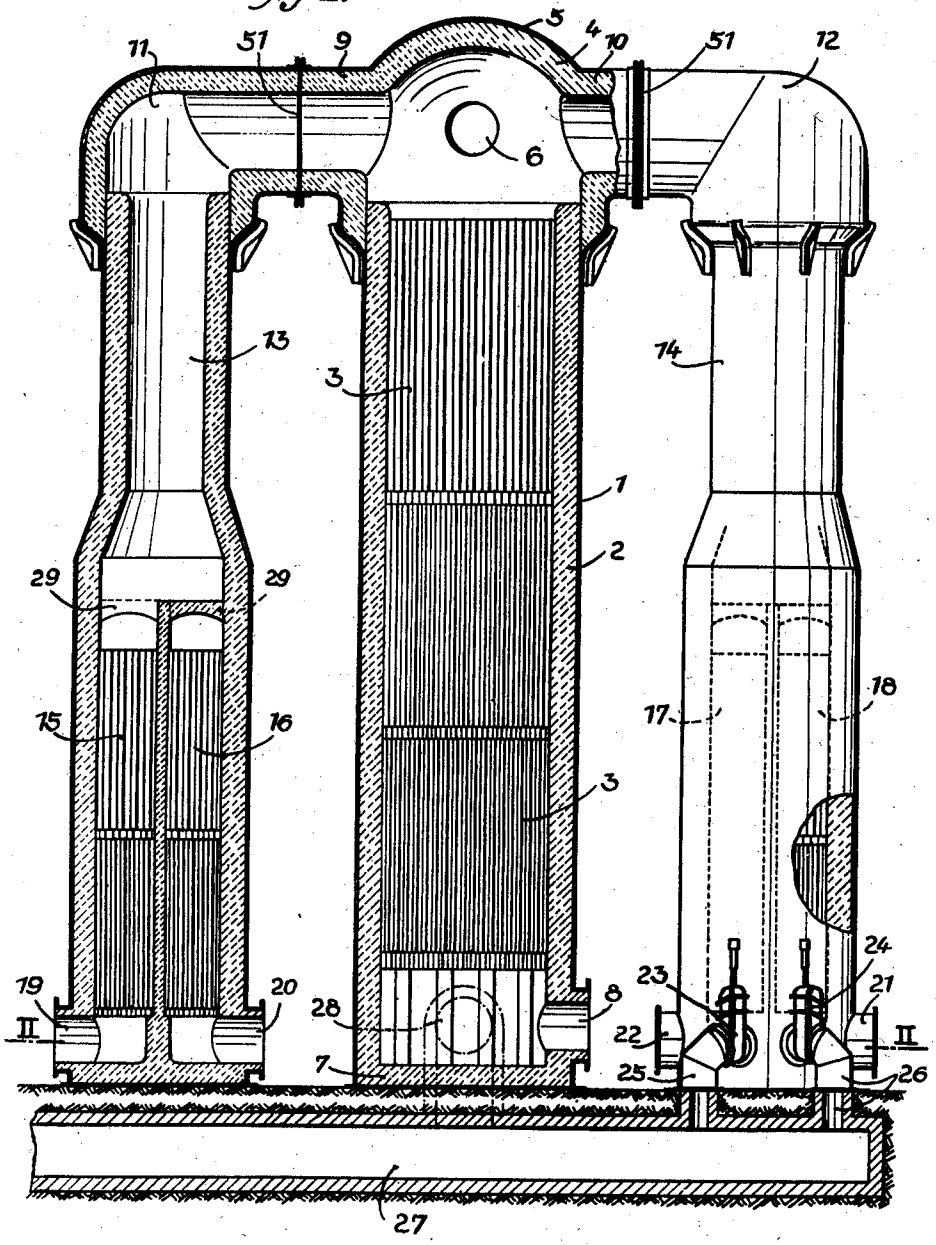
Dec. 20, 1938. J. DANIELS 2,141,036

REGENERATIVE HEATER AND THE LIKE

Filed July 11, 1936 3 Sheets-Sheet 1

Fig. 1.



Inventor:
Joseph Daniels
By Henry Loor Clarke
his atty

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REGENERATIVE HEATER AND THE LIKE

Filed July 11, 1936 3 Sheets-Sheet 2

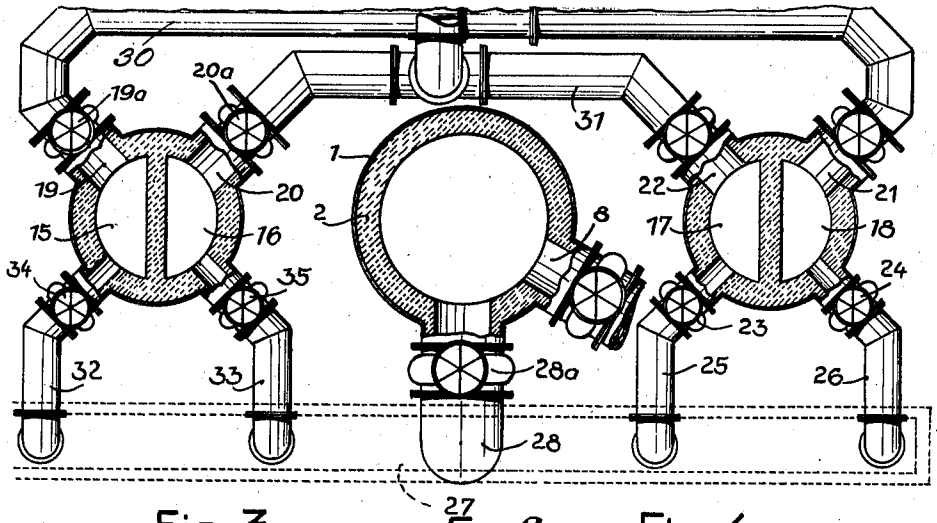

Fig. 2.

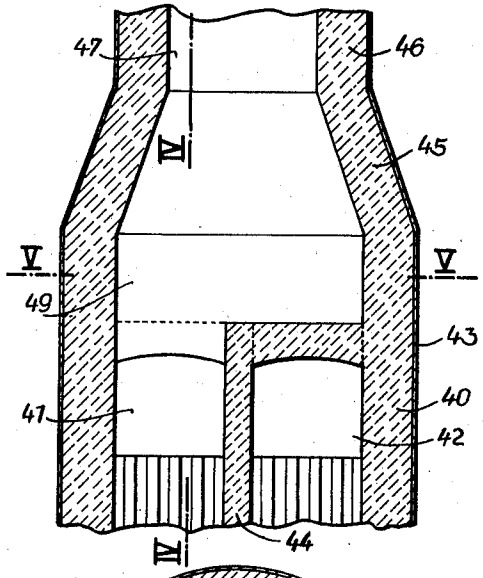

Fig. 3

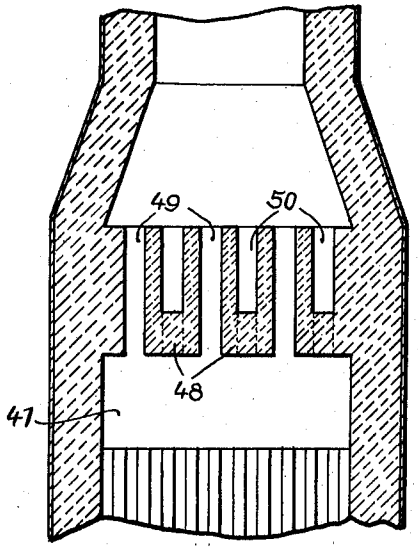

Fig. 4

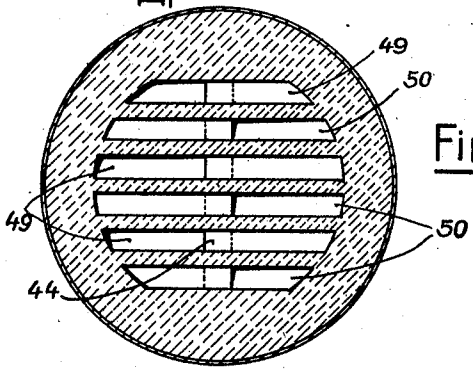

Fig. 5

Inventor:
Joseph Daniels
By Henry Lee Clarke
his atty.

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REGENERATIVE HEATER AND THE LIKE

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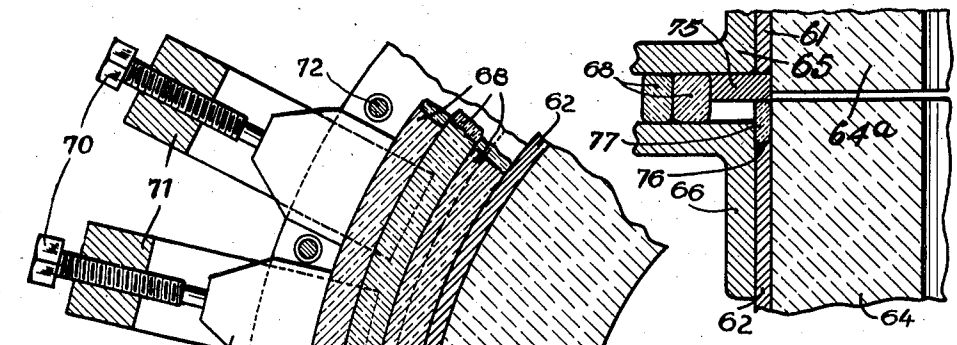
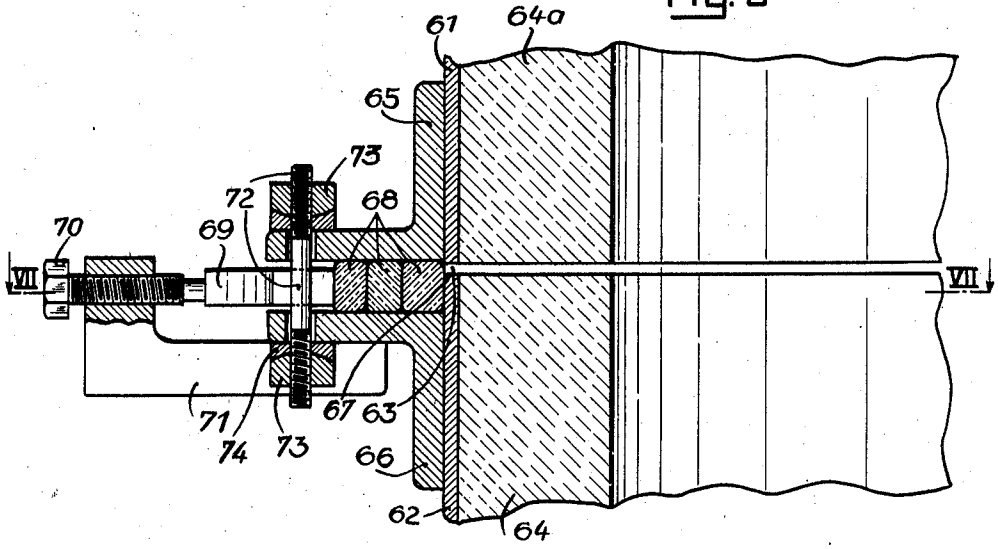


Fig. 8

Fig. 7

Fig. 6



Inventor
Joseph Daniels
By Henry Lee Clark
Atty

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UNITED STATES PATENT OFFICE

2,141,036

REGENERATIVE HEATER AND THE LIKE

Joseph Daniels, Essen, Germany, assignor, by mesne assignments, to Koppers Company, Pittsburgh, Pa., a corporation of Delaware

Application July 11, 1936, Serial No. 90,201
In Germany July 13, 1935

11 Claims. (Cl. 263—19)

The invention relates to apparatus, well-known under the name of regenerators, serving for heating-up media in gaseous or vapour form, and especially to those heaters, in which the refractory checkerwork or other means acting as heat accumulating element is arranged inside a tower-like casing, which is traversed upwardly by the media to be heated, in vertical or in an essentially vertical direction.

The heaters as described above, are often used to preheat the air for the operation of blast furnaces, as required. The hot blast stoves, which are used for the blast furnaces, are also called Cowpers. Similar heaters are furthermore used for heating up the gases during the continuous production of water gas from a mixture consisting of water-gas and steam, which is raised to a high temperature by the hot blast stoves and which mixture is thereafter brought into contact with the fuel to be gasified, whereby the steam and the carbon of the fuel is converted into water gas. In the continuous manufacture of water gas and also in other cases, it is sometimes necessary that the mixture of steam and water gas should be completely subjected to a high temperature to cause for instance certain reactions in the mixture which must be completed before the heated mixture can be further used.

Such gas heaters hitherto known and having the shape of a tower, like the so-called Cowpers tower, are constructed in such a way, that the media to be heated up are introduced at the bottom of the heater into an inner space which is filled-up with refractory brickwork and after having passed upwards through the checkerwork they enter a vertical channel which is connected at the top of the heater with the inside of the casing of the heater above the refractory checkerwork space.

This channel is usually formed by refractory brickwork and is likewise only separated from the checkerwork space by a partition, built of refractory bricks, since a separation wall, which would consist of a metal, for instance steel plate, would not withstand the high temperatures existing in the heater. The expansion of the refractory bricks due to their heating-up might easily cause cracks in the partition wall between the channel and the checkerwork space, so that gases from the checkerwork space could escape into said channel, without having first passed through the zones of highest temperature in the checkerwork. In this way certain amounts of the gases to be heated-up are not brought to the desired high temperature. The efficiency of the heater is thus considerably affected.

One object of my present invention is to provide such improvements in tower-like gas heaters (Cowpers) that no short circuits of the gases from the checkerwork's space of the heater into the gas channel alongside the checkerwork part of the heater, can take place, except through the connecting duct situated in the top of the heater.

Another object of my present invention is to provide improvements in the so-called tower-like gas heaters so that gases of a low calorific value, for instance producer gas can be made use of for heating-up the heater.

By the combustion of gases of a low calorific value, for example producer gas, comparatively low temperatures can only be arrived at. In order to obtain, however, higher combustion temperatures with such gases, it is customary to preheat the combustion media, that is the air for combustion as well as the fuel gas. Regenerators are often used for preheating the media; they can be heated up by hot combustion gases in one operating period. During the next operating period, the regenerators give off the heat they have stored up to the heating media, i. e. the combustion air and fuel gas. The usual regenerators are so arranged, that the hot waste gases can be conducted through same after they have given off their main heat content in another zone for the purpose under consideration. Therefore, in the usual regenerators that amount of heat is recovered and used, which is still contained in the combustion gases (waste gases), after the sensible heat of said gases has been made use of. Insofar as the heating-up of the gas heater is concerned, utilization of the residual heat of the waste gases, after the waste gases have passed the gas heater and given off their heat to the checkerwork, for preheating combustion air and gas for reheating the gas heater is impossible and useless, since the waste gases after leaving the gas heater are of such a low temperature that it is not possible to withdraw from the same a practically useful quantity of heat. If for instance the waste gases would be withdrawn from the gas heater at such a high temperature that their sensible heat could still be used for heating-up the checkerwork of a regenerator for the combustion air or gas for reheating the gas heater, then the checkerwork of the gas heater would only be incompletely utilized for heating up the reaction media, for instance the gas-steam current which serves as a heat

carrier for the continuous water-gas production. My present invention shows, however, means by which a good utilization of the sensible heat of the combustion gases is rendered possible, which serve for heating-up the gas heater.

Still another object of my present invention is an improved design of the joint between the top of the gas heater and the shaft arranged outside the heater, according to the invention, into which the media for heating-up the gas heater can be introduced and through which the heated-up gases can be withdrawn from the heater for further use.

The following description of a preferred embodiment of my invention not only shows further objects of my invention but also the fundamental technical principles which according to my invention are to be applied for attaining the purposes claimed.

Fig. 1 of the drawings shows a vertical section and partly a side view of a gas heater arrangement constructed according to my invention.

Fig. 2 shows a horizontal section through the gas heater arrangement on line II—II of Fig. 1.

Fig. 3 shows on an enlarged scale a vertical section through a part of the regenerator and of the combustion shaft.

Fig. 4 is a vertical section of Fig. 3 on line IV—IV.

Fig. 5 shows a horizontal section of Fig. 3 on line V—V.

Fig. 6 shows on an enlarged scale a vertical section through a part of a connection between the top of the gas heater and the adjacent combustion shaft.

Fig. 7 is a vertical section of Fig. 6 on line VII—VII.

Fig. 8 is a view similar to Fig. 7 showing another mode of carrying out the sealing of the connecting point between the top of the gas heater and the combustion shaft.

Referring now to Fig. 1, there is to be seen the essentially cylindrical shell 1 of the gas heater, which has approximately the shape of a tower, according to the type of the well-known Cowper. The shell 1 made of iron plate or another suitable material is lined inside with a refractory brickwork 2. In the space formed by the brickwork 2 is arranged checkerwork 3 consisting of refractory bricks. This checkerwork serves for storing-up the heat and is so equipped, that the gases introduced into the heater may flow through the heater in an essentially vertical direction and the direction may be frequently changed.

The inner space of the heater 1 is covered by a dome-like top 4, built of refractory material, which is surrounded by a metallic casing 5. The dome is suitably so equipped that the refractory brickwork 2 of the cylindrical part of the gas heater may extend into the free space of the dome, whereby the checkerwork is warmed-up.

In the dome 4 of the gas heater, there is provided an opening 6 for drawing-off the media to be heated up in the heater, which are introduced into the heater through an opening 8 situated at the bottom 7. The openings 6 and 8 by the interconnection of shut-off valves are connected with suitable pipelines for the media to be supplied to and to be withdrawn from the heater, not shown on the drawings for simplicity's sake. In one operating period, after the refractory brickwork 3 has been warmed up, the media to be heated up will be passed from the bottom to the top of the heater, whereby they take up the heat from the checkerwork and they are brought to the desired temperature.

The dome 4 of the gas heater is preferably fitted at the opposite ends with pipe branches 9, 10, to which are connected the pipelines 11, 12, leading to the vertical shafts 13, 14. These vertical shafts 13, 14 form the upper continuation of the regenerator pairs 15, 16 and 17, 18, which are arranged at both sides of the gas heater. The regenerators 15, 16, 17, 18 are lined with a refractory checkerwork similar to the heater 1, which checkerwork serves for storing up the heat. The bottom of the regenerators are provided with openings 19, 20, 21, 22, through which the combustion media to be heated up can be introduced into the regenerators. Furthermore, the regenerators are provided at the bottom with openings which are controlled by the valves 23, 24, 34, 35. These openings are in connection with the waste gas collecting channel 27 by the pipelines 25, 26, 32, 33. Likewise, the lower part of the gas heater 1 is connected with the waste-gas collecting channel 27, by a channel 28, which is governed by a valve 28*a*. The operating method of the apparatus shown in Fig. 1 is essentially as follows:—

It is assumed, that the checkerwork 3 of the gas heater has been cooled down and that it must be heated-up afresh. For this purpose the connection to the pipelines conducting the media to be heated-up has to be interrupted by closing the openings 8 and 6. A combustible gas for instance producer gas is then introduced from the pipeline 30 through the opening 19 into the regenerator 15, and air from the pipeline 31 through the opening 20 into the regenerator 16. Simultaneously, the valve 23 and the valve 24 of the regenerators 17 and 18 are opened so that they are in connection with the waste-gas channel 27. Finally, the valve 28*a* by which the connecting channel 28 is regulated, is opened, so that the gas heater 1 is also in connection with the waste gas channel 27. The heating media now flow upwards in the regenerators 15 and 16, which in a previous operating period have been brought to the desired high temperature. The heated-up media now leaves the regenerators 15 and 16, through the slots 29, then they reach the vertical combustion shaft 13, where they are mixed and burnt. The inner space of the shaft 13 consisting of the refractory brickwork is suitably so large, that the combustion flames may develop freely in the shaft, without combustion taking place at the surface of the refractory brickwork, which under certain circumstances may be damaged thereby. The hot burnt combustion gases then flow through the pipelines 11, 9, into the dome-like top of the gas heater, descending through the checkerwork 3 and giving off their heat to the checkerbrick therein.

A part of the hot combustion gases flows from the top of the gas heater through the pipelines 10, 12, into the other combustion shaft 14 and from here they pass through the regenerators 17, 18, by which the checkerwork is heated-up; finally they reach the waste-gas collecting channel 27, through the ducts 25 and 26. In a similar way the waste gases from the bottom of the gas heater flow through the pipelines 28 into the waste-gas collecting channel 27. The quantity of the hot combustion gases flowing through the gas heater 1 and through the regenerators 17 and 18 is so adjusted, that the checkerwork 3 of the gas heater and the considerably smaller checkerwork of regenerators 17 and 18 are si-

multaneously brought to the desired temperature.

As soon as the checkerwork 3 of the gas heater 1 and the checkerwork of the regenerators 17 and 18 have attained the desired temperature, the supply of the heating media to the regenerators 15 and 16 is stopped by closing the openings 19 and 20 by the valves 19a and 20a. When the interior of the gas heater is to be freed from the waste gases, it is advisable to introduce through the regenerators 15, 16 a suitable media for instance steam which eliminates the waste gases from the heater 1 by purging. The waste gas valves 28a, 23 and 24 are now closed. Thereupon the gas to be heated-up is again introduced into the gas heater 1 through the opening 8, after the opening 6 has been previously opened.

When the temperature of the checkerwork 3 of the gas heater has dropped so far that the media to be heated-up no longer attain the desired temperature in the gas heater, the opening 8 and the opening 6 are again closed. The regenerators 15 and 16 are now connected by opening the valves 34, 35 with the waste gas collecting channel 27 and the gas heater is connected by the channel 28, with the waste gas collecting channel 27. A combustible gas for instance producer gas is then introduced through the opening 21 into the regenerator 17 and air is led through the connecting opening 22 into the regenerator 18. The heating media are heated-up in the previously heated regenerators 17 and 18 and they are burnt at a high temperature in the shaft 14. The hot combustion gases then reach the top of the gas heater, from where a portion flows through the checkerwork 3 of the gas heater and another portion through the regenerators 15 and 16. The checkerwork 3 and the checkerwork of the regenerators 15 and 16 are thus brought again to the desired temperature, whereupon after opening and closing the inlets and outlets, as described above, the media to be heated up are again passed through the gas heater 1.

As may be seen from the foregoing, there are available for every heating-up period heated regenerators for preheating the heating media so that even at the use of a gas with a lower calorific value, for instance producer gas, it is possible to attain a high temperature within the gas heater.

The invention is not restricted to special regenerators arranged underneath the combustion shafts 13 and 14 for preheating the heating media. But it is also possible to preheat the heating media in recuperators. In this case the top of the gas heater is suitably only connected with one combustion shaft at which bottom the preheated heating media are preferably introduced finely atomized, so that the media are burnt in the shaft with a flame of a comparatively short length.

The combustion shaft can in this case also be suitably used for discharging the gases to be heated up by the gas heater from the top of the heater. It is, of course, understood, that in this case the opening 6 in the top of the heater is not necessary and the gas main connected therewith is instead connected with the bottom of the combustion shaft.

The preferred mode of carrying out my invention with respect to the means which have to be provided in the lower part of the combustion shaft, in order to distribute the heating media well over the whole section of the shaft may be seen from Figures 3–5. In these figures the refractory brickwork 40 encloses the regenerators 41—42. Said refractory brickwork 40 is surrounded by a shell 43, consisting of steel plate or another suitable material. Both regenerators are separated by the wall 44. The regenerators 41, 42 correspond to the regenerators 15, 16, and 17, 18 in Figures 1 and 2 from an operating standpoint.

The refractory brickwork 40 has a slight conical taper above the regenerators 41, 42, as indicated at 45, and then extends into a cylindrical brickwork portion 46, which forms the burning or combustion shaft 47.

The regenerator space containing the refractory checkerwork which serves as a heat storing element, is limited above by a ceiling 48, in which are provided a number of slots 49, 50. The slots 49 are interconnected with the regenerators 41 and the slots 50 are connected with the regenerators 42. As shown in Figure 5, the slots 49, 50 extend over the whole section of the lower part of the conical portion of the burning shaft above the regenerators 41, 42. Consequently, gas and air are distributed practically uniformly over the whole section of the burning shaft, before they are mixed. By this extremely fine dividing-up, there is obtained a rapid combustion of the heating media. Only a short flame within the burning shaft is formed and secondary combustions which might damage the refractory checkerwork of the gas heater are avoided.

As illustrated in Figure 1, special connecting couples 51 are provided between the pipe branches 9, 10 in the top of the gas heater and the pipe lines 11, 12, leading to the burning shafts 13, 14. These connecting couples are so designed, that they permit a radial movement of the pipe branches 9, 10, against the pipe lines 11, 12, while maintaining a gas-tight joint between the two parts which are movable against each other. If the heater arrangement shown in Figure 1 is heated to the working temperature, not only the refractory brickwork expands, but also the steel shells of the gas heater and of the combustion shafts and of the regenerator pairs, respectively. A steel frame serves for supporting the combustion shafts in case the combustion shafts are not provided with the regenerator chambers lying underneath. The expansion of the shell of the gas heater and that of the shell of the combustion shafts and regenerators may be quite different since during the operation, the various parts of the apparatus are subjected to different degrees of expansion at the working temperature. Consequently, tensions may occur in the connecting line between the combustion shafts and the top of the gas heater, as for instance when the gas heater has expanded to a greater extent towards the top than the combustion shafts and regenerators. In order to avoid a cracking or leakages of the connecting lines, the tensions mentioned must be eliminated which is done according to my invention in such a way, that a compensator is arranged in the said connecting line, which permits a relative movement of the pipe pieces, 9, 10, against the pipes 11, 12.

The exact construction of this compensator may be seen from Figures 6 to 8. In these figures, the metallic casing for the connecting lines 11, 12 of Figure 1 is indicated in these figures by the numeral 61 and the casing of the connecting branches 9, 10, at the top of the gas heater is indicated by the numeral 62. Between the ends of both these casings 61, 62, is a narrow joint 63. These casings are lined with a refractory mate-

rial 64, 64a which is arranged at the connecting point 63 in such a way, that the brickwork 64, 64a can move under expansion and contraction against one another corresponding to the relative movement of the brickwork within the casings 61, 62.

A broad flange 65 is fastened to the end of the casing 61. Said flange 65 having a comparatively wide radially extending fronting face fronting towards a similar fronting face of a flange 66, which flange 66 is fixed at the end of the branch casing 62. The flange 66 is spaced however somewhat back from the end 67 of the pipe branch casing 62. If the casings 61, 62 fit closely against each other, without clamping into one another, there is formed between the fronting faces of the flanges 65 and 66 a free space of a comparatively large width. Elastic packings 68 are inserted into the space, for instance graphite asbestos cords or another suitable incombustible packing.

The packings 68 are pressed, by means of press-pieces 69, into the joint between the fronting faces of the flanges 65, 66. These press-pieces 69 are distributed over the whole circumference of the connecting joint. For the manipulation of these press-pieces the screws 70 are provided which are carried by hook-like extensions 71, fastened to the flange 66.

For connecting the flanges 65 and 66 with one another, there are provided axially directed screws 72, the nuts 73 of which, having the shape of a calotte, act against suitable pressure-rings 74. The holes in the flanges 65, 66 through which are passed the screws 72, are somewhat larger in diameter than the screws 72, so that with movement of the flanges 65 and 66 relative each other it is possible for the connecting screws 72 to assume an inclined position.

When carrying into effect the invention, the screws 72 are tightened so that the end faces of the casings 61, 62 do not completely fit firmly against each other, whereby a certain relative movement between these casings is made possible. By tightening the screws 70, the press-pieces 69 and thus the packings 68 are firmly pressed into the joint between the flanges 65, 66. The lowest packing 68 is thereby supported on the projecting end 67 of the casing 62, so that the packings 68 are pressed firmly against the front faces of the flanges 65, 66.

As may be clearly seen, the movable arrangement of the connecting screws 72 in conjunction with the elastic packing cords 68 and the adjusting screws 70 enables a movable and gas-tight connection between the two casings 61 and 62, which may be adjusted at any time.

In Figure 3 is illustrated a further embodiment of the invention with respect to the connecting expansion joints. In this embodiment, there is fastened at the ends of the casing 61 a special pressure ring 75, for instance by welding, which takes up the pressure of the packing material and which projects into the joint between the flanges 65 and 66. The end of the casing 62 is undercut a little, in this embodiment, and an elastic packing material 77 is situated in the joint between the undercut end 76 and the pressure ring 75.

I have above described my present invention on the lines of a preferred embodiment thereof, but my invention is not limited in all its aspects to the specific modes of construction described and shown, since the invention may be variously embodied within the scope of the following claims.

I claim:—

1. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, said means comprising a series of alternate gas and air inlet slots arranged side-by-side in a row across the combustion shaft for combustion with a flame of comparatively short length.

2. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing inner-lined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, said means comprising a series of alternate gas and air inlet slots arranged side-by-side in a row across the combustion shaft for combustion with a flame of comparatively short length; and said combustion shaft being provided with means for drawing off gases or vapours regeneratively heated in the regenerator.

3. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing inner-lined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, said means comprising a series of alternate gas and air inlet slots arranged side-by-side in a row across the combustion shaft for combustion with a flame of comparatively short length; and said combustion shaft being of such length that the combustion media will be substantially completely burnt therein before entering the checkerwork of the regenerator.

4. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing inner-lined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, said means comprising a series of alternate gas and air inlet slots arranged side-by-side in a row across the combustion shaft for combustion with a flame of comparatively short length; and said combustion shaft having inwardly and upwardly converging walls immediately over the row of slots forming a fire box tapering upwardly and inwardly into the combustion shaft.

5. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing inner-lined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, said means comprising side-by-side air and gas inlets, a series of partitions arranged side-by-side in a row and extending across both the air and the gas inlets, said partitions being spaced from each other providing a series of alternate gas and air passages therebetween each of which extends over and across both the air and the gas inlets, the air passages communicating with the air inlet therebeneath but being closed off from the gas inlet therebeneath and the gas passages communicating with the gas inlet therebeneath but being closed to the air inlet therebeneath.

6. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing inner-lined with refractory brickwork and having checkerbrick arranged inside said casing; means for introducing the gases and vapours to be preheated by the regenerator into the same below the checkerbrick therein, and means for withdrawing the gases or vapours preheated by the regenerator from the same above the checkerbrick therein; at least two combustion shafts arranged outside said casing and each connected at its upper part with the other and with the regenerator at their upper parts; each of said combustion shafts being provided at their lower parts with air and gas burner therefor and with a pair of air and gas regenerators therefor for the air and gas burner; and means for introducing air and gas alternately to the regenerators of one combustion shaft and then to the regenerators for the other combustion shaft; said combustion shafts being operable in alternation with each other to supply hot gases to the regenerator and to the other combustion shaft concurrently.

7. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, the connection of the regenerator casing and the combustion shaft with each other at their upper parts comprising a gas tight expansion joint adapted to accommodate expansion and contraction movement of the combustion shaft and regenerator casing, and its innerlining relative to each other; and in which the connection of the combustion shaft with the regenerator at their upper parts comprises separate pipes having an innerlining of refractory brick and an outer metal casing connected at their adjoining ends by the aforesaid expansion joint; and in which the expansion joint comprises a circumferential coupling ring on the end of each pipe casing, the ring on the combustion shaft pipe being provided with an enlarged circumferential confronting face extending radially of the pipe and movable relative to a correspondingly designed confronting face on the regenerator-pipe casing, and an elastic packing pressed in the space between the confronting faces by adjustable screws radially pressing the packing in gas-tight relation between the two confronting faces.

8. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, the connection of the regenerator casing and the combustion shaft with each other at their upper parts comprising a gas tight expansion joint adapted to accommodate expansion and contraction movement of the combustion shaft and regenerator casing, and its innerlining relative to each other; and in which the connection of the combustion shaft with the regenerator at their upper parts comprises separate pipes having an innerlining of refractory brick and an outer metal casing connected at their adjoining ends by the aforesaid expansion joint; and in which the expansion joint comprises a circumferential coupling ring on the end of each pipe casing, the ring on the combustion shaft pipe being provided with an enlarged circumferential confronting face extending radially of the pipe and movable relative to a correspondingly designed confronting face on the regenerator-pipe casing, and an elastic packing pressed in the space between the confronting faces by adjustable screws radially pressing the packing in gas-tight relation between the two confronting faces, and a series of axially extending connecting screws tieing the confronting faces to each other by a connection adapted to permit radial expansion and contraction of the pipes relative to each other while still tieing the confronting faces together.

9. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, the connection of the regenerator casing and the combustion shaft with each other at their upper parts comprising a gas tight expansion joint adapted to accommodate expansion and contraction movement of the combustion shaft and regenerator casing, and its innerlining relative to each other; and in which the connection of the combustion shaft with the regenerator at their upper parts comprises separate pipes having an innerlining of refractory brick and an outer metal casing connected at their adjoining ends by the aforesaid expansion joint; and in which the expansion joint comprises a circumferential coupling ring on the end of each pipe casing, the ring on the combustion shaft pipe being provided with an enlarged circumferential confronting face extending radially of the pipe

and movable relative to a correspondingly designed confronting face on the regenerator-pipe casing, the confronting face on one pipe terminating a distance back of the end thereof leaving an end of the pipe to support a packing between the two confronting faces, and an elastic packing pressed in the space between the confronting faces by adjustable screws radially pressing the packing in gas-tight relation between the two confronting faces.

10. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, the connection of the regenerator casing and the combustion shaft with each other at their upper parts comprising a gas tight expansion joint adapted to accommodate expansion and contraction movement of the combustion shaft and regenerator casing, and its innerlining relative to each other; and in which the connection of the combustion shaft with the regenerator at their upper parts comprises separate pipes having an innerlining of refractory brick and an outer metal casing connected at their adjoining ends by the aforesaid expansion joint; and in which the expansion joint comprises a circumferential coupling ring on the end of each pipe casing, the ring on the combustion shaft pipe being provided with an enlarged circumferential confronting face extending radially of the pipe and movable relative to a correspondingly designed confronting face on the regenerator-pipe casing, the confronting face on one pipe extending beyond the end thereof leaving an annular recess between the end of the pipe and the coupling ring, an annular pressure ring secured to the abutting end of the other pipe casing and projecting radially outwardly alongside and in contact with the confronting face of the coupling ring therefor, an elastic packing in said recess and extending axially into contact with the pressure ring, and an elastic packing pressed in the space between the confronting faces by adjustable screws radially pressing the packing in gas-tight relation between the two confronting faces against the outer circumferential surface of the pressure ring.

11. Regenerative heaters for heating up gases or vapours comprising a regenerator constituted of a tower-like casing innerlined with refractory brickwork and having regenerator checkerbrick arranged inside said casing; at least one combustion shaft arranged outside said casing and communicably connected at its upper part with the top of the regenerator for flow of heating gases thereto, said combustion shaft being provided below its upper connection with the regenerator with means for introducing combustion media to the combustion shaft, the communicable connection of the regenerator casing and the combustion shaft with each other at their upper parts comprising a conduit extending transversely of the regenerator casing and the combustion shaft having a gas tight expansion joint intermediate its ends and adapted to accommodate lineal expansion and contraction movement within the conduit itself transversely of the combustion shaft and regenerator casing, as well as expansion movement of the regenerator casing and the combustion shaft relative to each other transversely of their axes.

JOSEPH DANIELS.