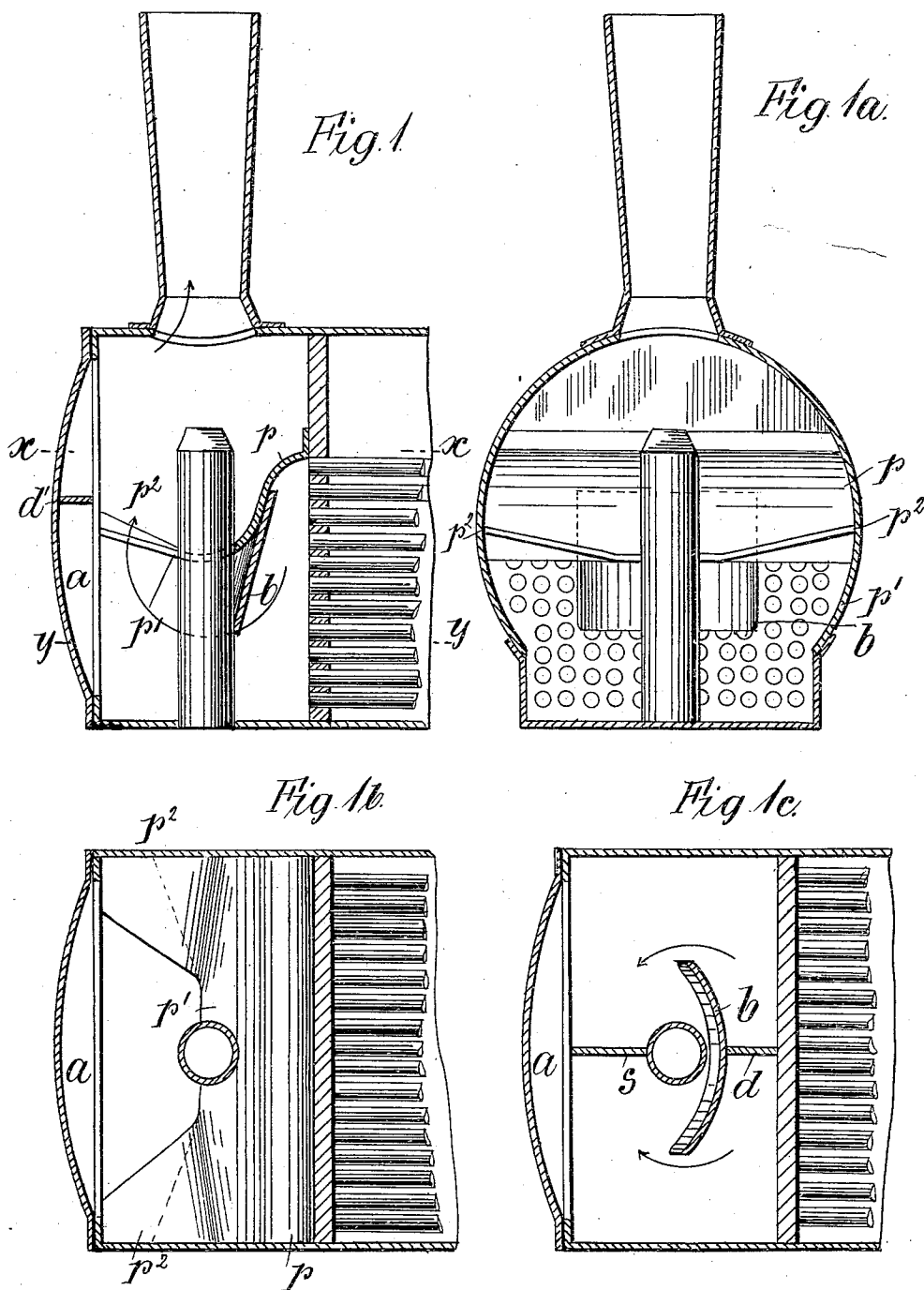


F. W. BORN.
 INTERIOR ARRANGEMENT FOR SMOKE BOXES OF TUBULAR BOILERS.
 APPLICATION FILED MAR. 7, 1906.

931,727.

Patented Aug. 24, 1909.

3 SHEETS—SHEET 1.



Witnesses:
 Harry Harper
 W. W. Demar Haupt

Inventor:
 Friedrich Wilhelm Born

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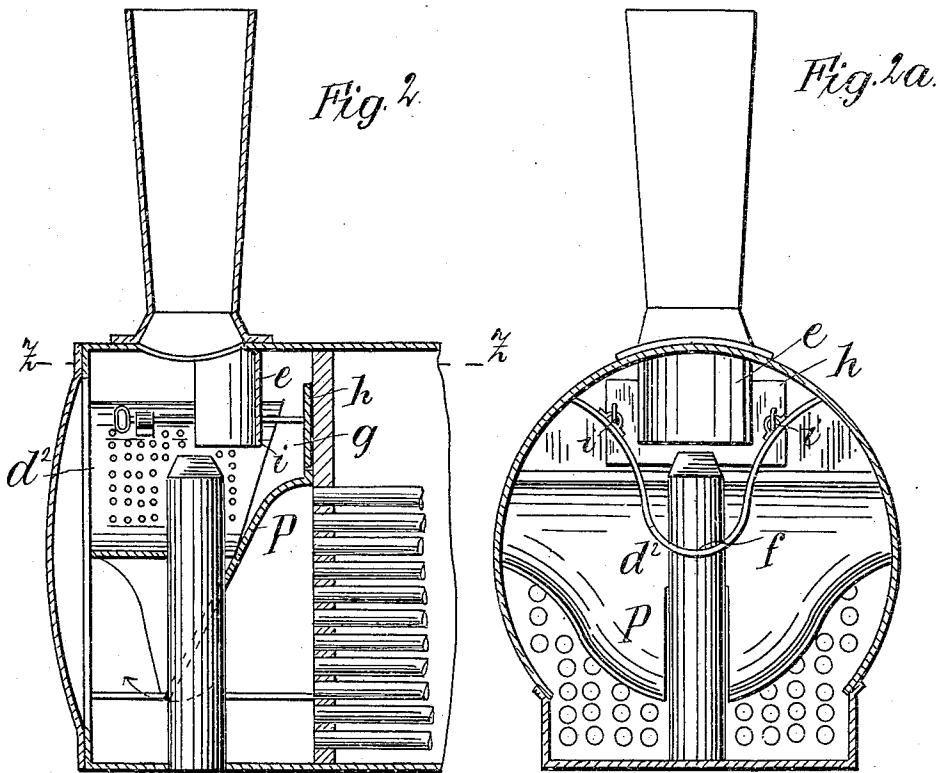
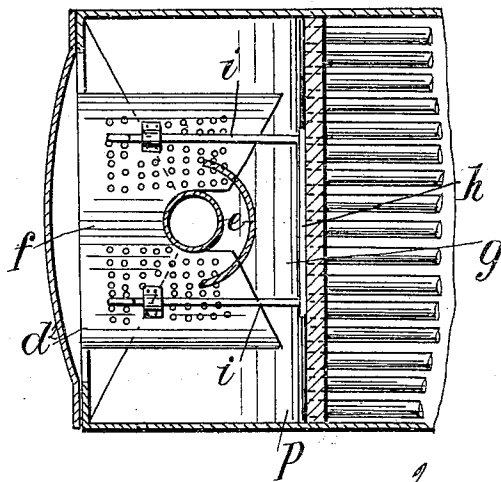


Fig. 2b.



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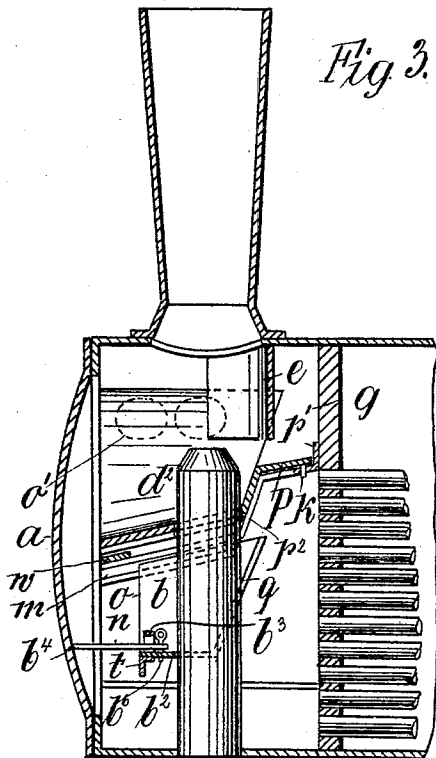


Fig. 3.

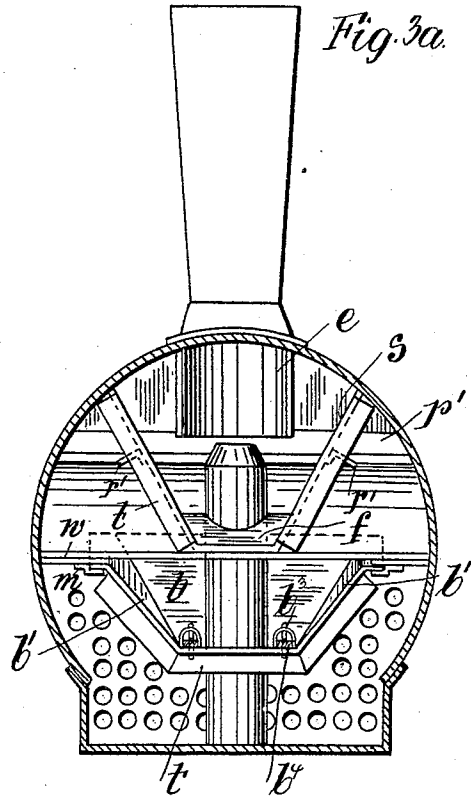
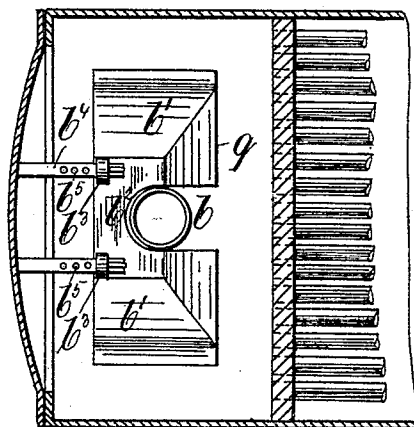


Fig. 3a.

Fig. 3b.



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UNITED STATES PATENT OFFICE.

FRIEDRICH WILHELM BORN, OF CHARLOTTENBURG, GERMANY.

INTERIOR ARRANGEMENT FOR SMOKE-BOXES OF TUBULAR BOILERS.

931,727.

Specification of Letters Patent.

Patented Aug. 24, 1909.

Application filed March 7, 1906. Serial No. 304,705.

To all whom it may concern:

Be it known that I, FRIEDRICH WILHELM BORN, a citizen of Prussia, residing at 143 Kantstrasse, Charlottenburg, in the Kingdom of Prussia, Germany, have invented a new and useful Interior Arrangement for Smoke-Boxes of Tubular Boilers, of which the following is a specification.

My invention refers to an improvement in the interior arrangement of smoke boxes for tubular boilers, which is particularly suitable for locomotive boilers; its purpose being to uniformly distribute the hot gases over the boiler tubes, to prevent sparks from being carried along in the said gases and to produce the most advantageous draft area.

In order to distribute, in tubular boilers, the hot gases coming out of the horizontal boiler tubes into the smoke box, uniformly through all boiler tubes, it has already been proposed to arrange in the smoke box above the uppermost row of boiler tubes a baffle plate extending downward in front of all boiler tubes, so that all gases as those coming from the upper and the middle boiler tubes are conducted downward and thereby conducted, so that they are forced to pass through the only possible passage into the chimney, that is through the opening remaining between the lower edge of said plate and the bottom of the smoke box, whereby a uniform distribution of the hot gases into all boiler tubes is supposed to be obtained. Tests have on the contrary shown, that the gases coming from the upper boiler tubes must for the said purpose be not only deflected downward but also laterally, whereas the hot gases coming from the middle boiler tubes must be conducted to the sides only, the gases proceeding from lower and lateral tubes must be allowed to escape freely. Such a deflection of the gases is obtained by the present invention by arrangement of a plate above the uppermost boiler tubes, said plate being in its first portion slightly inclined downward, then extending toward the door and the sides of the smoke box. In front of the middle boiler tubes is arranged a second plate leaving the boiler tubes on the sides entirely free. By the arrangement of such plates the result is that all boiler tubes are uniformly heated and can be utilized for the production of steam, which was proved by the tubes being free of soot, ashes and particles of coal even after several months service. By this means a considerable saving of

coal may be obtained and owing to the uniform draft the quantity of particles of coal carried along will not be so great. The particles of coal nevertheless carried along will be arrested by the baffle-plate and will accumulate in the bottom of the smoke-box, so that the plate will serve at the same time as a spark-arrester, without a grate or a screen having to be arranged in the smoke chamber.

The present invention is shown in the accompanying drawings, in which—

Figure 1 is a longitudinal section in a vertical line through the smoke box of a locomotive, chosen to exemplify the interior arrangement of smoke boxes according to the present invention. Fig. 1^a is a vertical cross section through the smoke box of a locomotive according to Fig. 1. Fig. 1^b a horizontal cross section along line $x-x$ of Fig. 1. Fig. 1^c is a horizontal cross section along line $y-y$ of Fig. 1, but showing in addition the partitions s and d . Fig. 2 is a longitudinal section in a vertical line through another modification of the interior smoke box according to the present invention. Fig. 2^a is a vertical section through the smoke box of a locomotive according to Fig. 2. Fig. 2^b is a horizontal section along line $z-z$ of Fig. 2. Fig. 3 is a longitudinal section in a vertical line through another modification of the interior of a smoke box according to the present invention. Fig. 3^a is a vertical cross section through the smoke box of a locomotive according to Fig. 3. Fig. 3^b is a view of Fig. 3 seen from above after the upper boiler shell has been removed as also part of the arrangement itself.

According to Fig. 1 immediately above the uppermost boiler tubes a suitably bent plate $-p-$ is arranged the lower edge of which suitably remains somewhat above the horizontal plane $-y-y-$ through the middle boiler tubes. To this horizontal baffle plate $-p-$ a second baffle plate $-b-$, is attached or suitably made in one piece, extending downward in a vertical or somewhat inclined direction, the lower edge of this second baffle plate $-b-$ reaches a little below the plane $-y-y-$ through the middle boiler tubes, the said plate $-b-$ being bent in such a manner, as seen in Fig. 1^c, that it separates the current of gases consisting of the hot gases coming from the upper tubes and those from the middle boiler tubes, the two currents as thus produced being led upward along the smoke box door as shown by

the arrow. On the sides — p^2 — the baffle plate — p — is bent slightly upward. Hereby its effect for the outermost tubes at the sides is increased. The gases proceeding from the lower and lateral boiler tubes can escape freely upward through an opening in the baffle plate. As the gases proceeding from the furnace are inclined to mainly pass through the upper and middle boiler tubes, the draft in these tubes will be greatest. The gases entering the smoke box from these tubes will therefore have a sucking effect on the gases coming from the lower tubes and those situated more toward the sides. Therefore the vertical baffle plate — b —, by causing a lateral deflection of the gases, will also increase the draft in the boiler tubes situated at the sides. By means of the baffle plates — p — and — b — thus, in short, a more uniform draft in all boiler tubes is obtained. It has been found that particles of coal are mainly carried along in the upper boiler tubes. Such particles carried along by the hot gases are conducted downward by the shape of the baffle plate — p — and laterally by the plate — b —, and collect in the lower part of the smoke chamber. Sparks will therefore not be ejected from the funnel under ordinary circumstances as has been ascertained by tests, even if grids or sieves are not used. For the purpose of preventing sparks being carried along the surface of the gate — a — of the fire box, when the fire is being lighted or the exhaust nozzle is worked with live steam, a web — d' — is provided on the said gate, Fig. 1.

The dividing of the gases into two separate currents can be assisted by a vertical partition — d —, Fig. 1^c, arranged in front of the tube plate. Further a vertical partition — s — can be arranged between the gate — a — and the exhaust nozzle. Both these partitions are however not absolutely necessary. Also plate — p — need not reach with its lateral edges up to the gate — a —, as seen in Fig. 1^b, as it can terminate as shown by the dotted lines. The same effect as to conduction and uniform distribution of the fire gases is obtained, if as shown in Figs. 2 and 2^a, 2^b respectively, the two plates — p — and — b — according to the design exemplified in Figs. 1, 1^a and 1^b, are united into one single plate — P —, which is so shaped and arranged in the smoke box, that likewise the hot gases proceeding from the uppermost boiler tubes are deflected downward and laterally, the gases proceeding from the middle boiler tubes deflected laterally and divided into two currents and then conducted upward. For preventing sparks from being carried along in the smoke box the web — d' — arranged on the smoke box gate, Fig. 1, is here made in the shape of a strainer by which the gases are led backward up to the boiler tube plate where they strike

against a plate arranged in front of the stack and then proceed into the latter. The plate — P — is also here arranged immediately above the uppermost boiler tubes, is first inclined slightly downward and then extends in a suitable curve almost down to the lower edge of the smoke box gate, so that the gases proceeding from the upper boiler tubes are conducted downward and laterally and those gases proceeding from the middle boiler tubes deflected laterally and divided in two currents and then conducted to the lower edge of the smoke box chamber where they will again rise and strike against the strainer — d^2 — reaching up to plate — P —, the said strainer conducting the gases up to the lateral walls of the smoke box and the above plate — P — back to the boiler tube plate. Here the gases will flow again forward and before they escape from the smoke box they will strike against the plate — e — suitably of semi-circular shape arranged in front of the stack whereby any contained sparks will be separated and collect in the strainer at — f —. During the passage of the gases the greater part of the sparks is already separated at the lower edge of the smoke box gate and particularly on striking against the strainer.

In order to not impede the draft in short smoke boxes by the web — d' —, its sides as also the plate — e — can be perforated sieve like, as shown in Fig. 2^b.

Generally the draft of the engine will depend on the distance from the strainer to the tube plate. The space — g — between these two, Fig. 2^b, is therefore suitably made large enough to suit the draft of each single engine. If in fitting the arrangement the dimensions of this space are not properly gaged, the best suitable draft for a locomotive can be obtained, by arranging in space — g — a plate in front of the tube plate, which can be adjusted by rods — i — suitably guided for instance in the strainer — d^2 — from the smoke box gate for the draft peculiar to each single engine.

For the purpose of obtaining by the arrangement shown in Figs. 2, 2^a, and 2^b not only a suitable conduction of the hot gases, but also a suitable regulation and increased effect as to the retaining of sparks carried along, the arrangements described as follows are provided, as shown in Figs. 3, 3^a and 3^b. Here again the same as in the design shown in Figs. 1, 1^a, 1^b, and 1^c a plate — P — is arranged above the uppermost boiler tubes and a plate — b — below the latter plate. Plate — P — consists here of two parts — p^1 — and — p^2 —. Part — p^1 — consists of a rail or frame plate fitted to the boiler tube plate, which extends laterally in suitable width along the walls of the smoke box to about half the depth of the smoke box, these lateral parts as may be seen from

the drawing, extending first in a broken line slightly downward, then sharply downward and then again slightly inclined downward so that the lower edges are preferably
 5 somewhat below the cross bar —*w*—, arranged horizontally in the middle in front of the smoke box gate.

Part —*p*²— consists of a plate lying loose on the lateral parts of the frame plate —*p*¹— the form of which loose plate is made to suit
 10 the shape of the lateral parts of the frame plate; the said loose plate is hooked with hooks —*k*— into holes formed in the part of the rail —*p*¹— attached to the tube plate
 15 whereby a secure hold is obtained.

The plate —*b*— arranged below the plate —*P*— is not simply curved like in the above description and rigidly connected with the plate —*P*— but made of box form and adjustable.
 20 The sides —*b*¹— of the box —*b*— rest with their upper bent over ends on rails —*m*— attached beneath lateral parts of the rail —*p*¹— as the box —*b*— may be moved on these rails —*m*— in such a manner that
 25 the space —*n*— between the front edge —*o*— of the box and the smoke box gate —*a*—, the so called draft area, can be varied and thus the box —*b*— be adjusted for the best draft suited for each engine.

The smoke and gases proceeding from the middle boiler tubes and a part of the gases coming from the upper boiler tubes and deflected downward by plate —*P*—, will strike against the wall —*q*— of box —*b*—, and are
 35 in consequence thereof given a downward direction. Besides however being thus directed downward they are directed to both sides and pass finally upward to the smoke box gate together with the other hot gases. Here
 40 at the smoke box gate they can escape upward through an opening in the baffle plate —*P*— and then strike against a strainer —*d*²— reaching up to the smoke box gate and the plate —*P*—, whereby the gases are conducted to the lateral walls of the smoke box
 45 and above the plate —*P*— back to the tube plate, whence they flow again forward and before escaping into the stack, strike against a plate —*e*— arranged in front of the stack having a half round bend, whereby sparks
 50 still carried along are separated and will collect in the strainer at —*f*—. During the passage of the gases the greater part of the sparks are separated at the lower edge of the
 55 smoke box gate, particularly in striking against the strainer.

The separation of the sparks can be considerably assisted by wings arranged at the front edge —*o*— of the box —*b*—, which
 60 wings are made detachable for replacing them if necessary by wider or narrower ones, or of either entirely or partly removing them, by which means another mode of producing the best suited draft area for each
 65 engine is afforded. A third means for ob-

taining this purpose is afforded by wings attached to the strainer at —*t*—, which wings are likewise made detachable and exchangeable. The space —*g*— between the strainer and the tube plate is generally made as large
 70 as suited for the most favorable draft, Fig. 3. When the smoke box is very short it can happen, that this space —*g*— can not be made large enough, in such cases, openings —*o*¹— can be arranged, as shown by dotted
 75 lines in Fig. 3, in the sides —*s*— of the strainer near to the walls of the smoke box, beneath which openings likewise detachable and exchangeable webs —*v*¹— are arranged. The sides —*s*— of the strainer can if necessary
 80 be also arranged adjustable as slides to be drawn out of the smoke box.

For affording a steady support for the box —*b*— resting on the rails —*m*— inclined downward toward the front, the bottom
 85 —*b*²— of this box has two eyes —*b*³— made in the shape of handles for moving the box by, which eyes serve as guide for rods —*b*⁴—. Rods —*b*⁴— strike against the smoke box gate and are drawn more or less out of the
 90 box according to the required size of the spaces between the front edge —*o*— of box —*b*— and the smoke box gate and secured in such position by pins —*b*⁶— inserted into the
 95 respective holes —*b*⁵—, so that the box —*b*— is securely held in its position.

The above described arrangement affords the further advantage that the tube plate can be readily laid bare for the purpose of
 100 cleaning the boiler tubes, for which purposes the box needs be only drawn out from its guides and part —*p*²— of plate —*P*— be lifted off part —*p*¹—.

The above described types of the interior arrangement for smoke boxes can be employed
 105 not only in locomotive boilers but also in any other tubular boilers as for instance in marine boilers, portable engines and the like. Preferably all parts are fitted in such a manner in the smoke box, that they
 110 can be easily and readily removed for cleaning purposes, or lifted respectively, and that they can easily be exchanged, in case of wear.

Having thus described my invention what I claim and desire to secure by Letters Patent
 115 of the United States is:

1. In a steam boiler furnace the combination of a smoke box, fire tubes leading thereto, an exhaust nozzle situated therein, and baffling means, the upper portion of which
 120 extends from above said fire tubes downwardly and away from the same to a point adjacent the exhaust nozzle, causing the products of combustion from the upper tubes to pass downward and around the lower
 125 edge of said upper portion, the lower portion of said baffling means being situated in front of the middle fire tubes and having its sides curved away from said tubes, the gases which pass around the sides thereof
 130

intermingling with those that pass through said upper fire tubes, the ends of the fire tubes at the sides of the lateral edges of said lower portion of the baffling means and below the bottom edge of said portion being free, substantially as and for the purpose described.

2. In a steam boiler furnace the combination of a smoke box, fire tubes leading thereto, an exhaust nozzle situated therein, and baffling means, the upper portion of which extends from above said fire tubes downwardly and away from the same to a point adjacent the exhaust nozzle, causing the products of combustion from the upper tubes to pass downward and around the lower edge of said upper portion, the lower portion of said baffling means being situated in front of the middle fire tubes and having its sides curved away from said tubes, the gases which pass around the sides thereof intermingling with those that pass through said upper fire tubes, the ends of the fire tubes at the sides of the lateral edges of said lower portion of the baffling means and below the bottom edge of said portion being free, the middle part of the upper portion being removably disposed in the smoke box, substantially as and for the purpose described.

3. In a steam boiler furnace the combination of a smoke box, fire tubes leading thereto, an exhaust nozzle situated therein, and baffling means, the upper portion of which extends from above said fire tubes downwardly and away from the same to a point adjacent the exhaust nozzle, causing the products of combustion from the upper tubes to pass downward and around the lower edge of said upper portion, the lower portion of said baffling means being situated in front of the middle fire tubes and having

its sides curved away from said tubes, the gases which pass around the sides thereof intermingling with those that pass through said upper fire tubes, the ends of the fire tubes at the sides of the lateral edges of said lower portion of the baffling means and below the bottom edge of said portion being free, said lower portion being adjustable in the longitudinal direction of the smoke box, substantially as and for the purpose described.

4. In a steam boiler furnace the combination of a smoke box, fire tubes, leading thereto, an exhaust nozzle situated therein and baffling means, the upper portion of which extends from above said fire tubes downwardly and away from the same to a point adjacent the exhaust nozzle, causing the product of combustion from the upper tubes to pass downward and around the lower edge of said upper portion, the lower portion of said baffling means being situated in front of the middle fire tubes and having its sides curved away from said tubes, the gases which pass around the sides thereof intermingling with those that pass through said upper fire tubes, the ends of the fire tubes at the sides of the lateral edges of said lower portion of the baffling means and below the bottom edge of said portion being free, the forward edges of the lower adjustable portion having removable wings, substantially as and for the purpose described.

In witness whereof I have hereunto signed my name this 20th day of February 1906, in the presence of two subscribing witnesses.

FRIEDRICH WILHELM BORN.

Witnesses:

HENRY HASPER,
WOLDEMAR HAUPT.