Aug. 3, 1943. C. B. HOAK 2,325,677

ANNEALING FURNACE

Filed Jan. 23, 1940 3 Sheets-Sheet 1

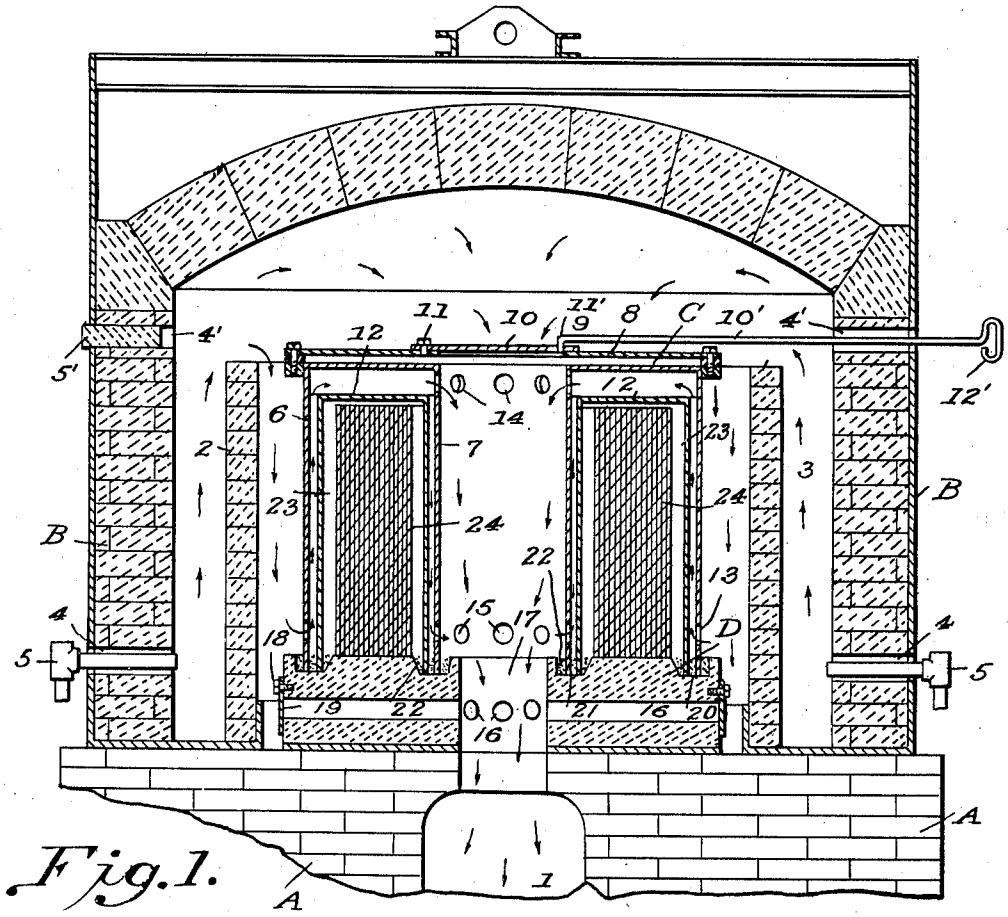


Fig. 1.

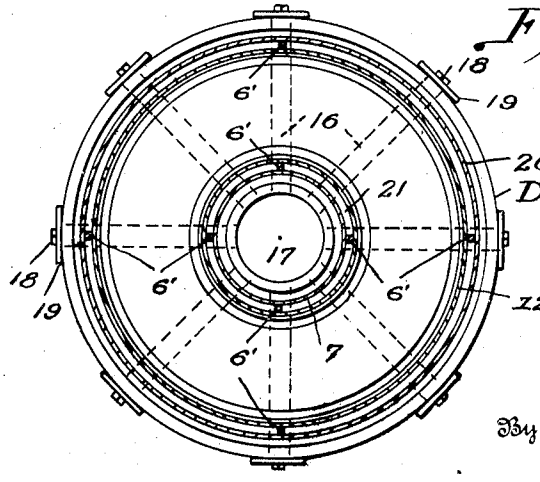


Fig. 3.

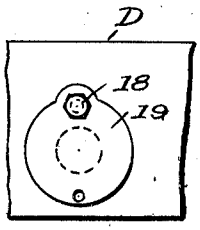


Fig. 2.

Inventor
CLARENCE B. HOAK

By Milans & Milans
Attorneys

Aug. 3, 1943. C. B. HOAK 2,325,677

ANNEALING FURNACE

Filed Jan. 23, 1940 3 Sheets-Sheet 2

Fig. 4.

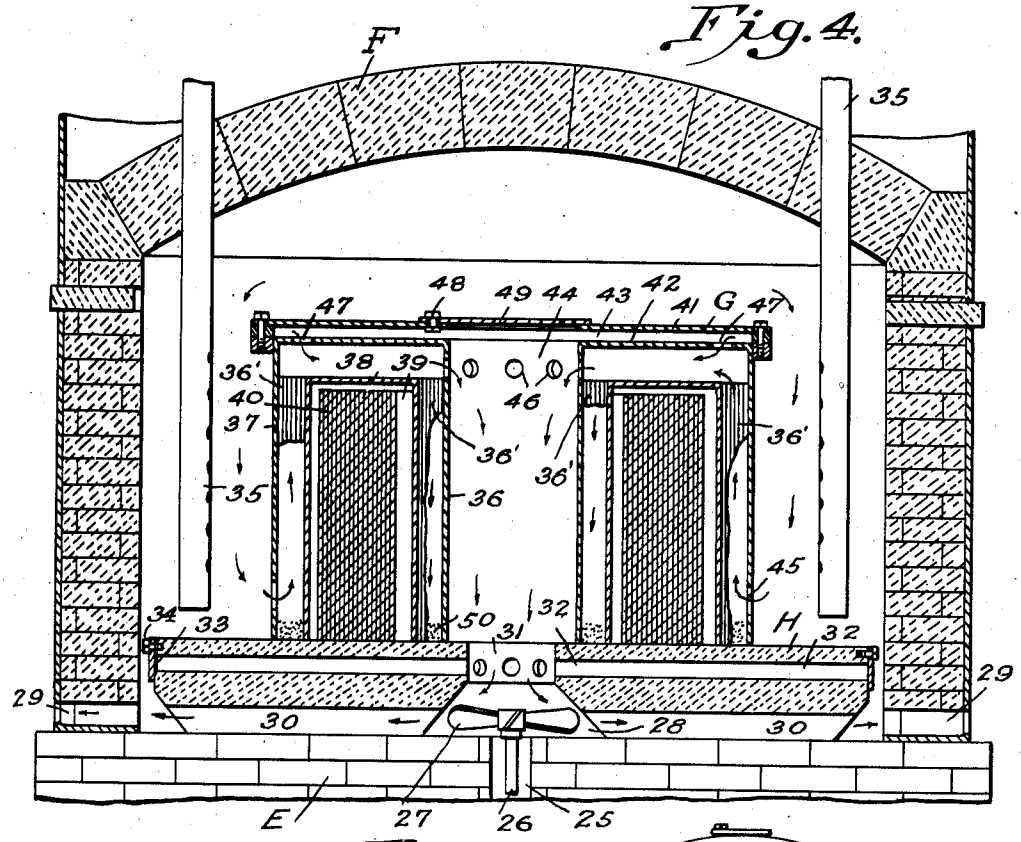


Fig. 6.

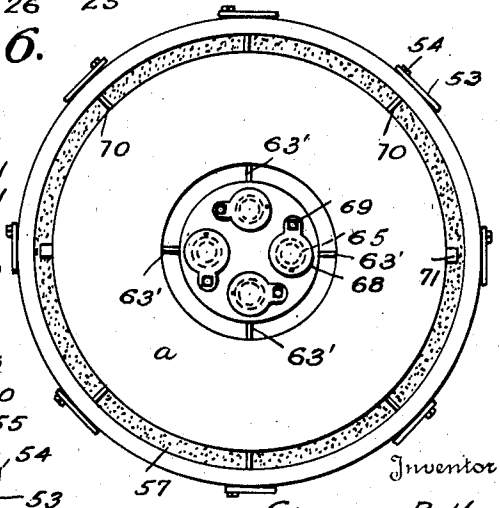
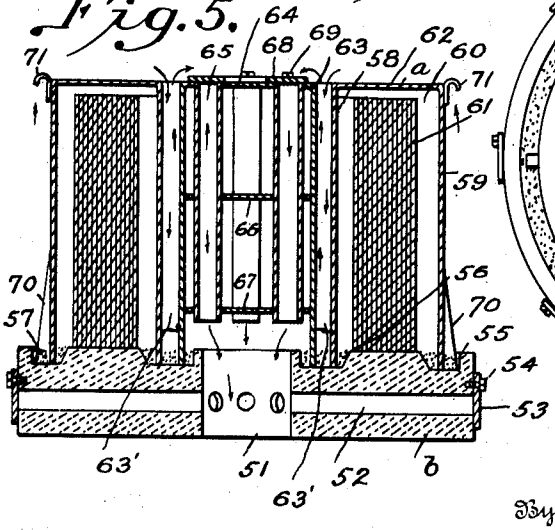


Fig. 5.



Inventor

CLARENCE B. HOAK

By Milans & Milans

Attorneys

Aug. 3, 1943. C. B. HOAK 2,325,677

ANNEALING FURNACE

Filed Jan. 23, 1940 3 Sheets-Sheet 3

Fig. 7.

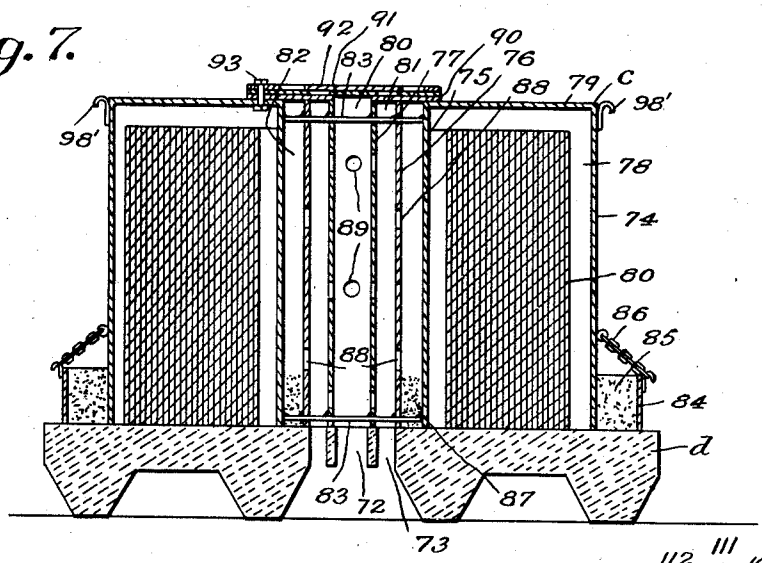


Fig. 9.

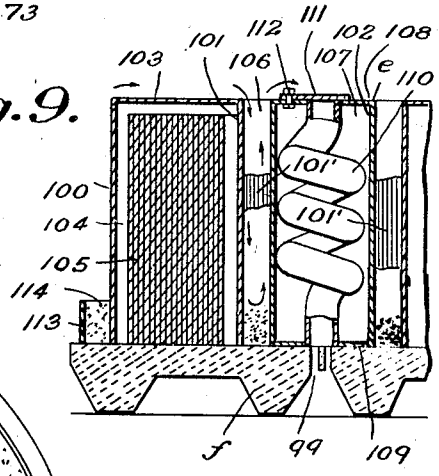
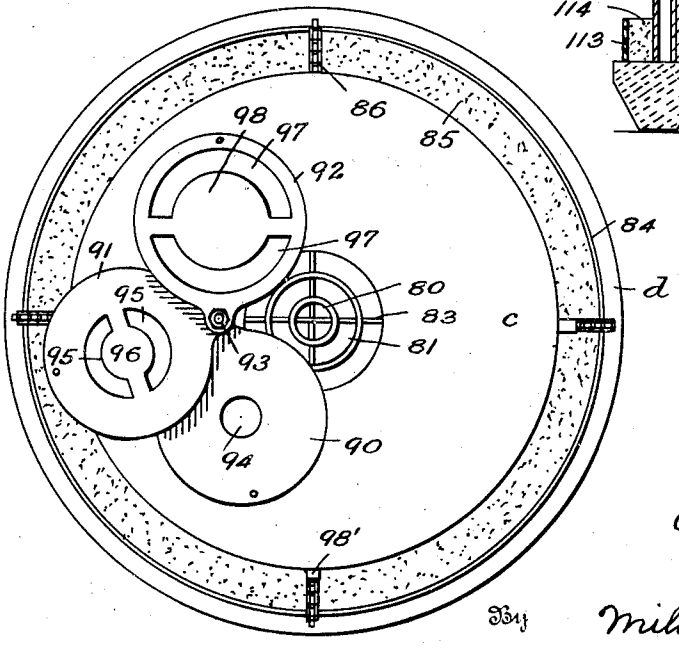


Fig. 8.



Inventor
CLARENCE B. HOAK

By Milans & Milans

Attorneys

Patented Aug. 3, 1943

2,325,677

UNITED STATES PATENT OFFICE

2,325,677

ANNEALING FURNACE

Clarence B. Hoak, Steubenville, Ohio

Application January 23, 1940, Serial No. 315,234

2 Claims. (Cl. 266—5)

My invention relates to new and useful improvements in an annealing furnace particularly adapted for the annealing of rolled steel strip and has for its principal object the provision of a furnace of the muffle type including an outer heat insulating wall or cover and an inner heat conducting muffle, the muffle having a chamber for enclosing the material to be operated upon.

Another object of the invention resides in the provision of a novel form of muffle or muffles including a regulating damper or dampers whereby the flow of heat or cooling currents may be regulated at the will of the operator and to meet the requirements of the material being operated upon, it being understood it will be desirable to change the heating currents according to the weight of the material, it being necessary to circulate more heat around a larger mass or unit than it is around a smaller mass or unit, in order to bring all of the units of steel up through their heat range at the same rate. By the use of the regulating damper or dampers the heating gases or cooling air currents can be regulated to vary the rate of heating or cooling of the interior of the coils of steel, wire, etc.

With the above and other objects in view, my invention consists in the novel details of construction, and arrangement of parts, described in the following specification and illustrated in the accompanying drawings, and while I have illustrated and described the preferred embodiments of the invention, as they now appear to me, it will be understood that such changes may be made as will fall within the scope of the appended claims.

In the drawings:

Fig. 1 is a transverse vertical section through a furnace of the character described with parts shown in elevation.

Fig. 2 is a horizontal section through the muffle cover of Fig. 1, the muffle base or pan being shown in top plan.

Fig. 3 is a detail showing in elevation one of the dampers or regulators used in connection with passages through the muffle base or pan.

Fig. 4 is a view similar to Fig. 1 showing a slightly modified form of furnace.

Fig. 5 is a transverse vertical section through a slightly modified form of muffle.

Fig. 6 is a top plan of the muffle shown in Fig. 5.

Fig. 7 is a transverse vertical section through a further modified form of muffle with parts shown in elevation.

Fig. 8 is a top plan of the muffle shown in Fig. 7 with the dampers or regulators swung into substantially open position; and

Fig. 9 is a fragmental transverse vertical section through a still further modified form of muffle with parts shown in elevation.

Referring more particularly to Figs. 1 to 3 inclusive of the drawings A represents the furnace base or floor, B the outer heat insulating wall or cover and C the muffle cover supported on the muffle base or pan D. The furnace base or floor A is formed with the exhaust opening 1 and the outer heat insulating wall or cover includes the inner partition wall 2, cylindrical in form, and providing the passage 3 for the heating or cooling currents. The outer wall or cover B is further provided with the circumferentially spaced openings 4 and at 5 I have shown burners having portions projecting through the openings 4 and terminating in the passage 3. Peep holes are shown at 4' and are adapted, when not in use, to be closed by the plugs 5'.

The muffle cover C includes the outer cylindrical wall 6, inner cylindrical wall 7 and top 8, the top 8 being formed with an opening 9 registering with the central passage or opening formed through the muffle cover by the inner wall 7. The opening 9 is adapted to be closed by the damper or regulator 10 pivotally connected to the top 8 at 11, this being shown more particularly in Fig. 1 of the drawings. The muffle cover C also includes the cylindrical hood 12 which is open at its bottom and closed at the top, this hood being connected to the walls 6 and 7 by the circumferentially spaced vertical strips 6', shown more particularly in Fig. 2, to be movable therewith. The hood is of such a size as to be spaced from the outer wall 6 and the inner wall 7 and there is also a space above the hood all of which is quite clearly illustrated in Fig. 1. The outer wall 6 is provided, adjacent its lower end, with circumferentially spaced openings 13 and the inner wall 7 is provided, adjacent its upper end, with the circumferentially spaced openings 14 and adjacent its lower end with the circumferentially spaced openings 15.

The muffle base or pan D is formed with the horizontal circumferentially spaced openings or passages 16 which extend from the outer surface of the base or pan and communicate with a vertically extending opening 17 formed through the base or pan and which opening communicates with the exhaust opening 1. Pivotally connected at 18 to the outer surface or edge of the base or pan D are the dampers or regulators 19 in the form of plates, these plates or dampers being swung to open or close the openings or passages 16 to regulate the flow of currents through the base or pan.

In its upper surface or face the base or pan D is formed with the circumferentially extending concentric recesses 20 and 21, these recesses receiving the lower edges of the muffle cover walls, as shown more particularly in Fig. 1 of the drawings, and sand or luting shown at 22 will be placed in these recesses 20 and 21 to form a tight seal between the base or pan and the muffle cover. The hood 12 forms the cylindrical chamber 23

which receives the material 24, to be operated upon, the material resting upon the muffle pan or base and enclosed by the muffle cover C.

In the form of the invention shown in Figs. 1 to 3 inclusive of the drawings the gas currents will pass in the directions shown by the arrows and the flow of the heating currents through the muffle cover and muffle base or pan may be regulated by the dampers or regulators 10 and 19. I am, of course, aware that in the annealing of material it is old to use a muffle including a muffle cover and base and that the heat is circulated around the muffle and through passages therein. However, I am not aware of the previous use of dampers or regulators for controlling the passage of heat through both the muffle hood and muffle base or pan, this being advantageous in the annealing where different size masses of material are used. Where a larger mass is to be treated more heat is necessary than is required in the treatment of smaller masses. If the temperature of the base or pan is to be increased the regulators or dampers 19 will be swung to open these passages and if it is desired to increase the heat through the muffle cover C the damper or regulator 10 will be swung to uncover the opening 9 and to permit a greater amount of heat currents to pass downwardly through the central passage of the cover and out through the exhaust openings 17 and 1. While I have illustrated the furnace as containing only one muffle it will be understood that a plurality of units might be used and when this is done the dampers or regulators are of further advantage in that one unit may require a greater amount of heat than the other unit. When it is desired to cool the cooling currents may be passed through the furnace in the same directions as is the heating current and these cooling currents may be regulated or controlled by the dampers or regulators 10 and 19. It will be further understood that the furnace wall or cover B, as well as the muffle cover C, may be raised in any of the usual well-known ways for placing the material to be operated upon on the muffle base or pan or for the removal thereof. The dampers 10 and 19 may be adjusted at will by hand or by the engagement of a suitable instrument. In Fig. 1 of the drawings I have shown a rod 10', having a hook 11', at one end and engaged in an opening in the damper 10, the rod passing through one of the peep holes 4' and formed at its outer end with a hand-engaging portion 12'. By manipulation of the rod the damper may be swung on its pivot.

In Fig. 4 of the drawings I have illustrated a slightly modified form of furnace and muffle in which E shows the furnace base or floor, F the outer wall or cover adapted to be supported by the base or floor E, G the muffle cover, and H the muffle base on which the cover G is supported. An exhaust opening 25 is formed in the base or floor E and extending through this opening 25, and rotatably supported in a manner not shown, is a shaft 26 on the upper end of which is secured a fan 27 operable in a recess 28 formed in the muffle base H. This fan acts as a suction fan for drawing the heating or cooling currents through the furnace and muffle and for discharging the same in a manner which will be later apparent. The outer wall or cover F is formed, adjacent its lower end, with the circumferentially spaced exhaust openings 29 and in substantial alignment with these openings are grooves or passages 30 formed in the bottom surface of the muffle base H. These grooves or passages extend from the outer edge of the base to the recess 28 and also communicating with this recess 28 is an opening 31 which extends to the upper surface of the base. Extending from the opening 31 are the circumferentially spaced openings or passages 32 which are adapted to be closed at their outer ends by means of the dampers or regulating plates 33 pivotally connected to the marginal edge of the base H as shown at 34. At 35 I have illustrated burners which pass through the top of the cover F downwardly to the position shown in the drawings. While these burners are, of course, adapted for supplying heat interiorly of the furnace they may, when desired, be used for conveying cool air in the cooling operation.

The muffle cover G includes the concentrically arranged inner and outer walls 36 and 37 respectively, between which is supported, by the circumferentially spaced vertical strips 36', the cylindrical hood or cover 38, this hood 38 forming a chamber 39 for the reception of the material 40 which is preferably in the form of rolled sheet strip. The hood is of such a size as to leave passages between the same and the inner and outer walls 36 and 37 as well as a space or passage above the top thereof. The muffle cover is also formed with the upper and lower top plates 41 and 42 respectively, forming a space 43 therebetween, and each of these top plates 41 and 42 is formed with a central opening communicating with the central passage 44, formed by the inner wall 36, and the lower end of this passage 44 communicates with the opening 31 in the base H. The outer wall 37 is formed with the circumferentially spaced openings 45, adjacent its lower edge, and the inner wall 36 is likewise formed with circumferentially extending openings 46. The top plate 42 of the muffle is formed with the circumferentially spaced openings 47 and in operation the heating or cooling currents will be passed in a direction indicated by the arrows, passing through the openings 45, then around and over the hood 38 to be discharged through the openings 46 into the passage 44, from which they are drawn by the fan 27 through the opening 31 and discharged outwardly through the grooves or passages 30 and finally through the openings 29 in the wall or cover F.

Pivotally connected at 48, to the top plate 41, is a damper or regulating plate 49, and this plate is adapted to be positioned as shown in Fig. 4 to close the opening in the top plate 41. When desired this damper or regulator plate 49 may be swung to uncover the central opening in the plate 41 so that the heating currents or cooling currents may be directed through the top plate opening and supply an additional amount of heating or cooling currents through the opening or passage 44. It will be understood that the top plates 41 and 42 form a space therebetween which is not closed at the marginal edge so that a certain amount of the currents may pass therebetween and through the openings 47.

The heating or cooling currents, passing through the base H, may be regulated by the damper plates 33. When it is desired to pass currents through the openings 32 the damper plates may be swung to uncover the outer ends of the openings or passages 32 and either heated or cooled air may be drawn through these passages or openings thereby regulating the temperature of the base. The dampers or regulating plates 33 and 49 may be adjusted by hand or suitable instrument.

It will be noted that in Fig. 4 of the drawings,

as in the construction shown in Figs. 1 to 3 inclusive I provide novel means for regulating the air currents so that the currents may be regulated for masses of material varying in size. At 50 I have illustrated sand or luting for forming a seal between the muffle cover G and muffle base H.

In Figs. 5 and 6 of the drawings I have illustrated another form of muffle without illustrating any particular form of outer furnace construction. In this form of the invention the muffle cover is illustrated generally at *a* and the muffle base or pan at *b*. The muffle base or pan is formed with the central vertically extending opening 51 and leading from this opening 51 are the horizontal circumferentially spaced openings 52 which lead to the marginal edge of the base or pan. For closing the outer marginal ends of these openings 52 I provide the damper or regulating plates 53 which are pivotally connected at 54 and these plates or dampers may be operated to regulate the amount of heating or cooling currents passing through the base or pan. In its upper face or surface this base or pan *b* is formed with the circular concentric grooves 55 and 56 and these grooves receive the lower ends of the walls of the muffle cover, as shown, luting or sand being placed in the grooves as shown at 57 to form a seal between the muffle cover and base or pan.

The muffle cover, in the form of the invention disclosed in Figs. 5 and 6, includes the inner and outer concentric circular walls 58 and 59, spaced apart to provide a chamber 60, to receive the mass of material 61 to be operated upon. At the top the walls 58 and 59 are connected by a top plate 62. The inner wall 58 forms a central passage in which is positioned a cylindrical member 63, closed at the top by the plate 64, but open at the bottom, with its lower end received in the groove or recess 56. The member 63 is connected to the wall 58 by the circumferentially spaced vertical strips 63'. Positioned within the cylindrical member 63 are the vertically extending tubes or pipes 65, the upper ends of the pipes or tubes extending through the top plate 64 while the lower ends thereof are spaced above the lower end of the member, and above the top surface of the muffle base or pan *b*, as shown more particularly in Fig. 5 of the drawings. At 66 and 67 I have shown re-enforcing plates for properly positioning the tubes or pipes 65 within the cylindrical member 63. Pivotally connected to the top plate 64, of the cylindrical member 63 at 69, are the dampers or regulating plates 68, which are adapted to normally be swung to close the upper ends of the tubes or pipes 65. The dampers or regulating plates 68 may be adjusted by hand or suitable instrument. Secured to the outer face of the wall 59, of the muffle cover, are the strengthening T's 70, which extend to the lower end of the wall and are received in the groove 55, in the base or pan *b*. At 71 I have indicated hooks secured to the muffle cover so that operating mechanism may be connected thereto for raising or lowering the cover.

When the muffle is positioned in a furnace the heating or cooling currents will pass around the outer wall 59, of the muffle cover over the upper surface of the cover, and downwardly into the opening or passage formed between the inner wall 58 and the wall of the cylindrical member 63. It will be noted that there is no outlet at the bottom of this passage but the currents passing downwardly therein will again find their way upwardly. When it is desired to supply an additional amount of heat the dampers or regulator plates 68 may be swung to open the upper ends of the tubes or pipes 65 and then the heating or cooling currents may pass downwardly through these pipes or tubes and be exhausted through the opening 51 in the base or pan *b*. The temperature of the base or pan *b* may be regulated by operating the dampers or regulator plates 53. Normally the currents will be contacted with the upper surface of the base or pan and heat the same to a certain temperature. When desired the dampers or regulator plates 53 may be swung to open the outer ends of the openings or passages 52 so that currents of heating or cooling air may pass through the openings or passages.

In Figs. 7 and 8 of the drawings I have shown a still further modified form of muffle adapted for use in a furnace and this form of muffle includes the muffle cover *c* and the muffle base *d*. The base is formed centrally with the exhaust openings 72 and 73.

The muffle cover *c* includes the cylindrical concentric walls 74, 75, 76 and 77. The walls 74 and 75 form a chamber 78 closed at the top by the plate 79 to receive the material 80 to be operated upon, it being noted that the roll of material will rest upon the upper surface of the muffle base *d*. The cylindrical wall 77 forms the passage 80, the wall 76 forms the passage 81 and the wall 75 forms the passage 82. The cylindrical members 75, 76 and 77 are connected by the transversely extending rods or pins 83, adjacent the top and bottom ends. As shown more particularly in Fig. 7 of the drawings the bottom edges of the cylindrical walls 74, 75, 76 and 77 normally rest upon the upper surface of the base *d* and also received on the base is a ring or band 84 which forms a space or what might be termed a pan for receiving the sealing sand or luting shown at 85. The band or ring 84 is connected to the wall 74 of the muffle cover by the chains 86. Sand or luting may also be positioned on the base *d* in the passage 82 as shown at 87.

The cylindrical wall 76 is formed with the vertically and circumferentially spaced openings 88 while the cylindrical wall 77 is provided with the circumferentially and vertically spaced openings 89.

For normally closing the upper ends of the passages 80, 81 and 82 I provide the dampers or regulator plates 90, 91, and 92 which are pivotally connected to the top plate 79 at 93 and may be adjusted by hand or suitable instrument, such as is shown in Fig. 1. The damper or plate 90 is provided with the central opening 94 which when the plates are in closed positions communicates with the passage 80. The damper or plate 91 is formed with the arcuate-shaped elongated openings 95 which normally register with the passage 81. This plate 91 is also formed centrally with a portion 96, between the arcuate-shaped openings 95 to overlie the opening 94 in the plate 90 when the plates or dampers are in closed position. The top plate or damper 92 is formed similar to the damper or plate 91 with the elongated arcuate-shaped openings 97 and central portion 98. However, the openings 97 are nearer the marginal edge of the damper or plate 92 than are the arcuate-shaped openings 95 of the plate 91. When the plates or dampers are in the position shown in Fig. 7 of the drawings they will close the ends of the passages 80, 81 and 82, the plate 90 overlying the ends of the passages 81 and 82, the central part 96 of the damper or plate 91 overlying the central opening 94 of the plate or damper 90 and the damper

or plate 91 underlying the arcuate openings 97 in the damper or plate 92. When in this position the upper ends of the passages 80, 81 and 82 are closed. When it is desired to open the passage 80 the plates 91 and 92 are swung on the pivot 93 so as not to overlie the plate 90 and as the opening 94, in the plate 90, registers with the passage 80 heating or cooling currents may pass through the opening 94 and passage 80. If it is desired to open the end of the passage 81, while still keeping the passages 80 and 82 closed, the plates 90 and 97 will be swung and this leaves the openings 95, in the plate 90, registered with the passage 81. When it is desired to open the passage 82, while keeping the passages 80 and 81 closed, then the plates 90 and 91 will be swung leaving the openings 97, in the plate 92, registering with the passage 82. If it is desired to open all of the passages 80, 81 and 82 all of the plates or dampers may be swung as shown more particularly in Fig. 8 of the drawings. Different combinations of passages may be opened as may be found desirable by swinging the different dampers or plates or combinations thereof.

From the above detailed description it will be seen that when the muffle is positioned in the furnace the heating or cooling currents will normally pass therearound. Additional or less heating or cooling currents may be obtained by regulating the damper plates 90, 91 and 92 to permit the heating or cooling currents to enter the passages 80, 81 and 82. The currents may pass from the passage 82 into the passage 81 through the openings 88 and from the passage 81 into the passage 80 through the openings 89. The currents will be exhausted through the openings 72 and 73 in the muffle base. At 98' I have shown hooks to be engaged for raising and lowering the muffle cover.

In Fig. 9 of the drawings a further modified form of muffle is illustrated fragmentarily. In this form of my invention the muffle cover is shown generally at *e* and the muffle base at *f*, the muffle base having an exhaust passage shown at 99. The muffle cover consists of the cylindrical walls 100, 101 and 102, the wall 102 being connected to the wall 101 by the circumferentially spaced vertical strips 101'. The upper ends of the walls 100 and 101 are connected by the top plate 103 to form a chamber 104 for the material 105 to be operated upon. The cylindrical wall 102 is spaced from the wall 101 to form the passage 106 into which the heating or cooling currents will be discharged and circulated as shown by the arrows. The cylindrical wall 102 forms a chamber 107 closed at the top by the plate 108 and at the bottom by the plate 109, a central opening being formed in each of the plates for communication with ends of a coiled pipe or tube 110 received in the chamber 107. The lower end of the coiled pipe or tube 110, communicating with the central opening in the plate 109, communicates with the exhaust opening 99 in the muffle base *f*. As stated ordinarily the heating or cooling currents from the furnace will pass around and over the muffle cover *e* for entrance into the passage 106 as shown by the arrows. When it is desired to increase the heating or cooling currents the same may be discharged into and through the coiled pipe or tube 110. Normally the upper end of this coiled pipe or tube is closed by the damper or regulating plate 111, pivotally connected at 112, as shown in Fig. 9. When it is desired to pass the currents through the coiled pipe or tube the damper or regulating plate 111 will be swung on its pivot 112, by hand or suitable instrument, to uncover the upper end of the coiled pipe or tube so that the currents may pass therethrough. Supported on the muffle base *f* is a band or ring 113 concentric with the wall 100 and spaced therefrom. This band forms a space for the reception of the sealing sand or luting 104.

While I have illustrated several modifications of my invention it will be seen that in each instance I have shown means for regulating the heating or cooling currents so that the amount of heating or cooling air may be regulated according to the size of the mass of material being operated upon. In each of the forms of the invention the muffle cover is provided with dampers or regulating plates controlling passages and in some instances there are controlled passages formed in the muffle base or pan. My improved forms of muffle may be used in connection with various forms of furnaces and, as I have previously stated, while in the forms of the invention disclosed in Figs. 1 to 4 inclusive of the drawings I have only illustrated a single muffle or unit within the furnace a plurality of the same might equally as well be used. When this is done, by the use of my regulating dampers or plates the cooling or heating currents may be regulated or varied so that in one muffle or unit a large mass of material may be treated while in another unit or muffle a smaller mass may be treated.

Having fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an annealing furnace having a base and a removable insulating cover, a muffle supported on the furnace base and within the insulating cover, the muffle including a base and a removable cover, the muffle base having a vertical opening and horizontal passages leading therefrom to the margin of the base and the removable cover having a passage therethrough and a surrounding chamber to receive and enclose the material to be operated upon, the cover passage being arranged for communication with the interior of the furnace, to receive heating or cooling currents therefrom, and with the vertical opening in the base, a member operable relative to the end of the passage in the cover for forming or cutting off communication with the interior of the furnace and controlling the flow of currents from the interior of the furnace to and through the passage, and members mounted on the margin of the base and operable to open or close the ends of the horizontal passages at the margin of the base.

2. A muffle for annealing furnaces including a base and a removable cover, the base having a vertical opening and horizontal passages leading therefrom to the margin of the base and the removable cover having a passage therethrough to receive heating or cooling currents and a surrounding chamber to receive and enclose the material to be operated upon, the cover passage being arranged for communication with the vertical opening in the base, a member operable relative to the end of the passage in the cover for forming or cutting off communication to the passage, and members mounted on the margin of the base and operable to open or close the ends of the horizontal passages at the margin of the base.

CLARENCE B. HOAK.