Jan. 15, 1957 V. H. FERGUSON 2,777,683

UNIVERSAL HEAT TREATING APPARATUS

Filed Feb. 21, 1952 4 Sheets-Sheet 1

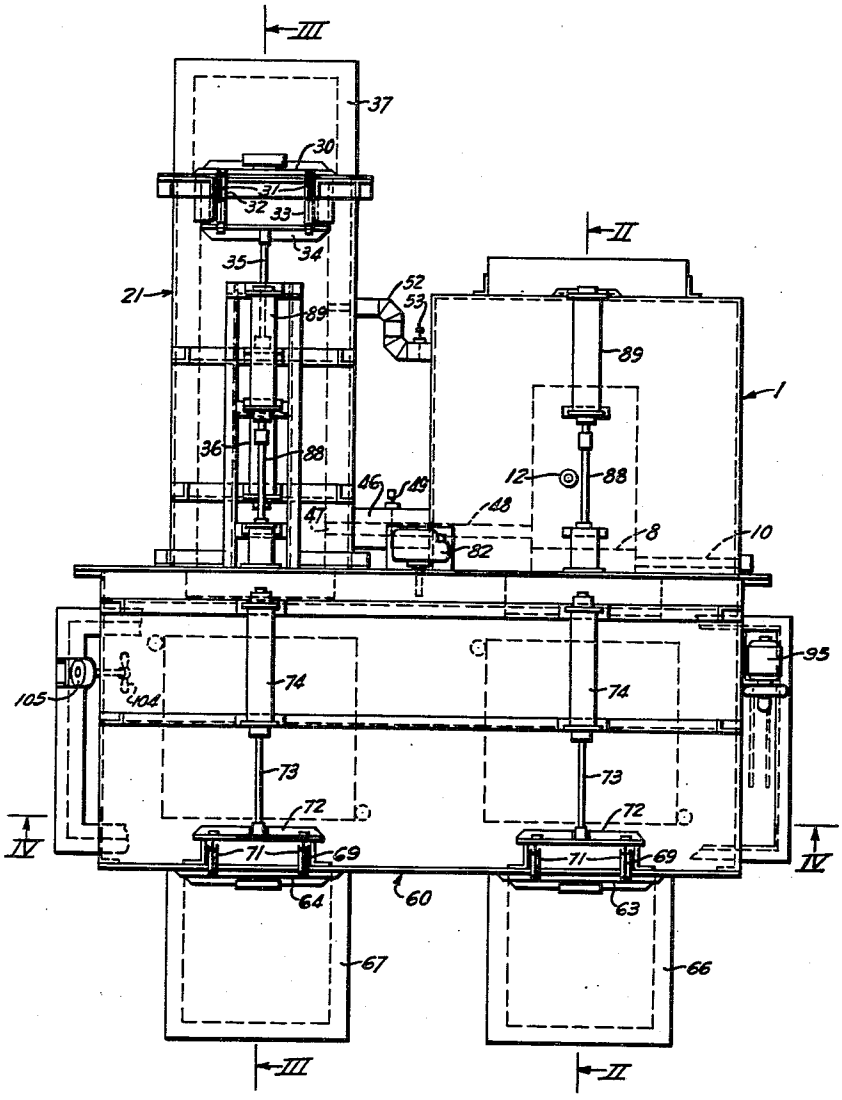

Fig. 1

INVENTOR.
VERNON H. FERGUSON
BY
Brown, Critchlow, Flick & Peebles
HIS ATTORNEYS

Jan. 15, 1957 V. H. FERGUSON 2,777,683

UNIVERSAL HEAT TREATING APPARATUS

Filed Feb. 21, 1952 4 Sheets-Sheet 2

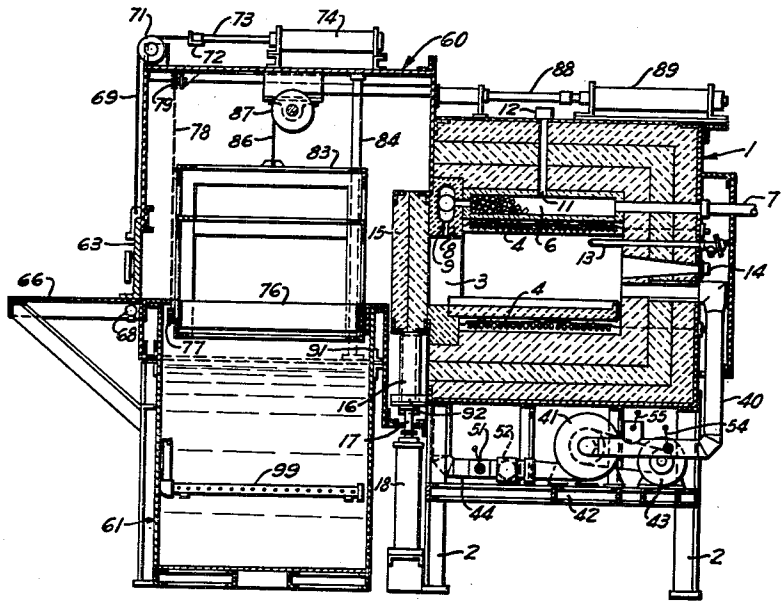

Fig. 2

INVENTOR.
VERNON H. FERGUSON
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

Jan. 15, 1957 V. H. FERGUSON 2,777,683

UNIVERSAL HEAT TREATING APPARATUS

Filed Feb. 21, 1952 4 Sheets-Sheet 3

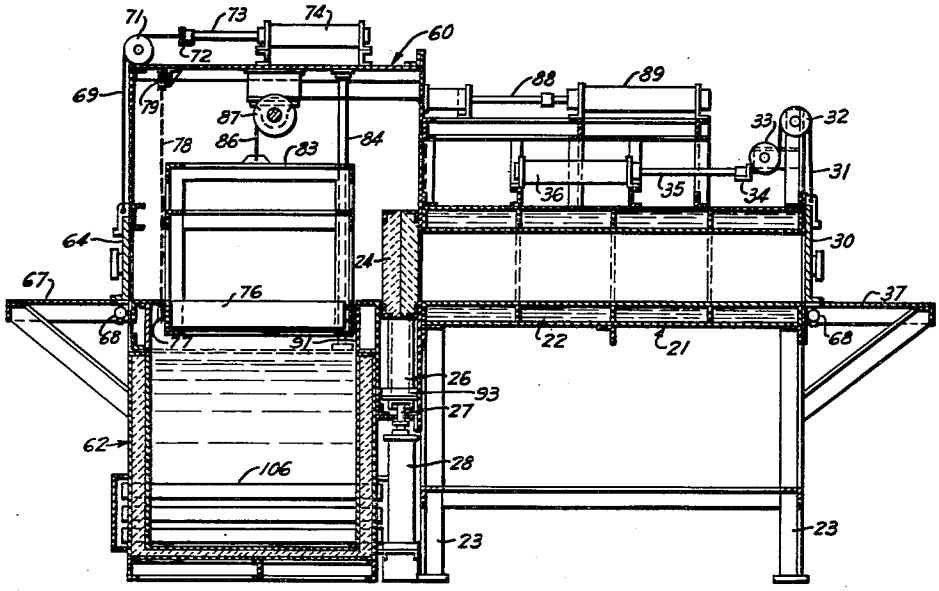

Fig. 3

INVENTOR.
VERNON H. FERGUSON
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

Jan. 15, 1957 V. H. FERGUSON 2,777,683

UNIVERSAL HEAT TREATING APPARATUS

Filed Feb. 21, 1952 4 Sheets-Sheet 4

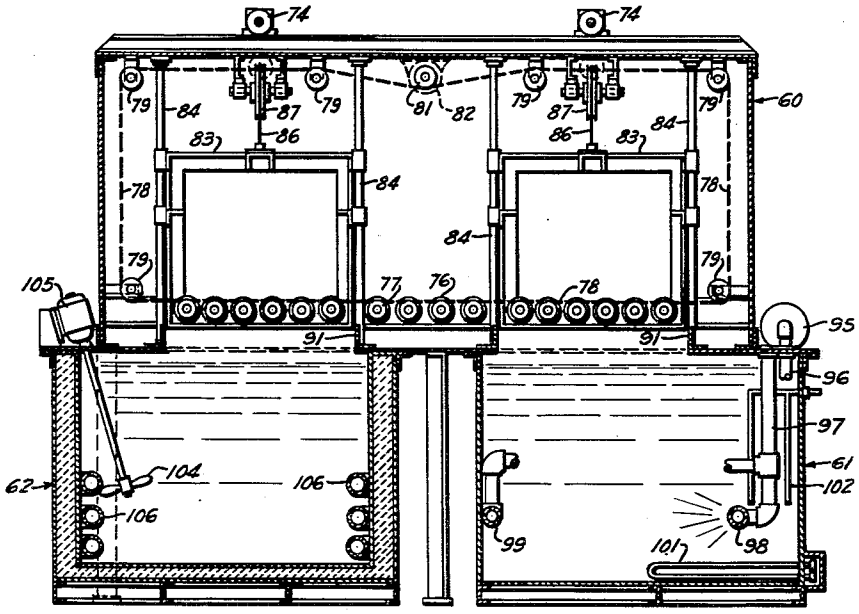

Fig. 4

INVENTOR.
VERNON H. FERGUSON
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

United States Patent Office

2,777,683

Patented Jan. 15, 1957

2,777,683

UNIVERSAL HEAT TREATING APPARATUS

Vernon H. Ferguson, Pittsburgh, Pa.

Application February 21, 1952, Serial No. 272,785

2 Claims. (Cl. 266—4)

This invention relates to metal treating apparatus which, by using it in various ways, permits almost any type of heat treating to be accomplished in one unit. It is especially suitable for heat treating on a small scale, such as in laboratories or tool rooms, but it also could be used for large production purposes where the type of heat treating varies from day to day.

It is among the objects of this invention to provide heat treating apparatus which is compact, which is easy to use and control, and which permits many different types of heat treating to be accomplished.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which Fig. 1 is a plan view of my apparatus; and Figs. 2, 3 and 4 are vertical sections taken on the lines II—II, III—III and IV—IV, respectively, of Fig. 1.

Referring to Figs. 1 and 2 of the drawings, a high temperature furnace 1, is supported a few feet above the floor by legs 2. The interior of the furnace is provided with a doorway 3 at its front end. Electric heating elements 4 or the like are disposed in the walls of the heating chamber. An endothermic gas generator 6 is built into the furnace, preferably above the upper heating elements, from which it receives most of its heat. The rear end of the generator is connected by a pipe 7 with a suitable source of fuel gas and air which react with a refractory and metal catalyst within the generator to cause reformation of the gas and air into a protective atmosphere for the work being heated in the furnace. This protective atmosphere passes from the front end of the generator into a hollow block 8 that forms the top of doorway 3. The chamber in this block is connected with the doorway of the heating chamber by means of vertical passages 9 in the block. One end of the block is connected with the outside of the furnace by a passage 10 through its side wall, so that methane or ammonia can be introduced into the block when desired. The generator is also connected by a vertical pipe 11 to the top of the furnace so that a hydrocarbon can be added to the generator when desired. Ordinarily the upper end of this pipe is closed by a cap 12.

A thermocouple 13 extends into the rear end of the furnace, and the back wall of the furnace is also provided with a sight opening 14. The doorway of the furnace is closed by a refractory door 15 supported by a U-shape metal frame 16 that is mounted on the upper end of a piston rod 17 extending down into a vertical cylinder 18. The door is opened by introducing air or other fluid pressure into the lower end of the cylinder so that the frame extends along the bottom and up the opposite sides of the doorway.

Now referring to Figs. 1 and 3, spaced a short distance from one side of the furnace is a cooling chamber 21 which has double walls, between which water 22 is circulated for cooling it. This cooling chamber likewise is mounted several feet above the ground on legs 23, so that the doorway at its front end will be at the same level as the doorway of the furnace. Also, the front ends of

the furnace and cooling chamber lie in the same vertical plane.

The front doorway of the cooling chamber is closed by a refractory door 24 mounted on top of a U-shape metal frame 26 that is supported by a piston rod 27 extending down into a fluid pressure cylinder 28. This door operates in the same way as the furnace door. The rear end of the cooling chamber is closed by a vertically sliding discharge door 30, which can be raised by a pair of cables 31 that pass up over sheaves 32 and then down under other sheaves 33 to a cross bar 34 fastened to the front end of a piston rod 35 that extends into an air cylinder 36 mounted on top of the chamber. A discharge table 37 supported by legs 23 and the cooling chamber, extends rearwardly from the discharge door.

The protective atmosphere that is fed into the front end of the furnace chamber from hollow block 8 is withdrawn from the rear end of the furnace through a pipe 40 that extends down to a high temperature fan 41 mounted on a frame work 42 beneath the furnace, as shown in Fig. 2. This fan is driven by an electric motor 43, and its outlet is connected to a pipe 44 that extends up between the furnace and cooling chamber and into the bottom of a short pipe 46 (Fig. 1) connecting a passage 47 into the front portion of the cooling chamber with a passage 48 extending through the adjacent side of the furnace to one end of the hollow block. The short pipe 46 is provided with a valve 49 between the cooling chamber and pipe 44. As long as this valve is closed, the protective atmosphere withdrawn from the furnace by the fan is conducted directly back to the hollow block for recirculation through the furnace. When it is desired to also circulate the protective atmosphere through the cooling chamber, a valve 51 in pipe 44 beneath the furnace is closed, and the atmosphere is diverted through a branch pipe 52 that extends into the rear portion of the cooling chamber. This branch pipe contains a valve 53 which is open only at that time. The valve 49 in short pipe 46 likewise is opened at that time so that the protective atmosphere in the cooling chamber can flow through the short pipe and back to the hollow block in the furnace. The pipe 40 that connects the back of the furnace with the inlet of the circulating fan is provided with a valve 54 for closing it, and with an inlet valve 55 that can be opened to allow fresh air to be drawn into the fan.

Disposed in front of the furnace and cooling chamber and connecting their doorways is a rectangular housing 60, called a vestibule, through which work can be transferred from the furnace to the cooling chamber without exposing it to the outside atmosphere. Doors 15 and 24 are inside the vestibule. The vestibule rests in sealing engagement on two tanks 61 and 62, one in front of the furnace and the other in front of the cooling chamber. The bottom of the vestibule is closed, except for openings over the tanks.

The front of the vestibule is provided with a pair of vertically sliding doors 63 and 64, one directly in front of the furnace door and the other directly in front of the front door of the cooling chamber. Tables 66 and 67 extend outward from beneath the doors. Beneath each vestibule door there is a perforated gas pipe forming a burner 68 that will provide a curtain of fire across the doorway above it when the door is opened, so that the atmospheres inside and outside the vestibule will not mix. The tables can be slotted to permit the flames to rise through them. Each door is opened by a pair of cables 69 which extend up over sheaves 71 to a cross bar 72 fastened to the front end of the rod 73 of a piston that is disposed in an air cylinder 74 mounted on top of the vestibule. When air is admitted to the front of the cylinder the door is raised.

The lower part of the vestibule contains a roller conveyer in which the rollers 76 have sprockets 77 on their outer ends. These sprockets are driven by a chain 78 above them which also extends around sprockets 79 supported by the vestibule and under a drive sprocket 81 at the top of the vestibule. This drive sprocket is driven by an air motor 82 suspended from the top of the vestibule. Some of the conveyer rollers above each tank are connected together in a group by mounting them in the lower part of a framework 83 which is slidable vertically on guide rods 84 rigidly mounted in the vestibule. Each framework and the rollers journaled in it form an elevator that can be lowered into the underlying tank by a cable 86 that passes over a sheave 87 in the upper part of the vestibule and extends out through the back of the vestibule to the rod 88 of a piston in an air cylinder 89 mounted on top of the furnace or the cooling chamber, as the case may be. Due to the fact that the driving chain 78 for the conveyer rollers engages the tops of the roller sprockets 77, the rollers of the elevators can be lowered into the tanks without interference from the chain and yet be driven by the chain when they are in their upper position. The openings in the bottom of the vestibule are surrounded by casings 91 that extend down into the liquid in the tanks to seal those openings from the outside air. When the elevators are in their upper position and the charging doors of the furnace and cooling chamber are raised to open them, bridges are formed between the top of the elevator rollers and the interiors of the furnace and cooling chamber by means of horizontal plates 92 and 93, mounted in the lower parts of the door-supporting frames 16 and 26, respectively.

The liquid in tank 61 in front of the furnace is circulated by means of a pump 95 mounted on one end of the tank. The pump has an inlet pipe 96 and an outlet pipe 97 that extends down into the tank to connect to perforated horizontal headers 98 and 99 along opposite sides of the tank. The liquid may be heated by an electric heater 101 in the bottom of the tank, or cooled by water-cooled hollow plates 102 immersed in the liquid at one end of the tank.

The liquid in the other tank may be circulated by a propeller 104 driven by an electric motor 105 mounted on one end of the tank. This tank also contains hollow electric electrodes 106 for heating the liquid. If it is desired to cool the liquid instead, the current to the electrodes is turned off, and cooling air is circulated through them.

In using this apparatus, the work is placed on the roller conveyer in front of the furnace by inserting it through the opened vestibule door 63. This door then is closed and furnace door 15 is raised to open it. The work then can be pushed into the furnace by means of a rod extending through a port in the vestibule door. After the desired heating in the furnace, the work is withdrawn onto the conveyer, and if it is to be quenched in oil, the conveyer rollers above tank 61 are lowered with the work into oil in that tank. After quenching, the elevator raises the work back to the level of the conveyer, from which it either can be withdrawn through the adjacent vestibule door, or it may be reintroduced into the furnace for drawing after the latter has been cooled down. When the furnace is being operated without a protective atmosphere, it is cooled by closing valve 54 and opening valve 55 to introduce outside air. If the furnace is operating with a protective atmosphere in it, it can be cooled by closing valve 51 and opening valves 49 and 53 so as to circulate the furnace atmosphere through the cooling chamber to cool that atmosphere without admitting outside air.

In case of austempering or martempering operations, the heated work is withdrawn from the furnace as before and the conveyer rollers are driven by means of the chain 78 so as to convey the work to the vertically movable group of rollers in front of the cooling chamber. These conveyer rollers then are lowered so as to lower the work into hot salt in tank 62. After this operation, the work can be withdrawn through vestibule door 64.

In case of brazing operations, the work is removed from the furnace and transferred by the conveyer to a point in front of the cooling chamber. Door 24 then is raised and the work is pushed into the chamber, from which it can be removed through rear door 30 after the work has cooled sufficiently.

The gas generator 6 above the furnace heating chamber provides a non-oxidizing, non-decarburizing atmosphere to protect the work in the heating chamber. In operating generator 6 with manufactured gas, additional hydrocarbon gases or liquids can be introduced into the generator through passage 11 as desired.

When carburizing, recarburizing, nitriding or dry cyaniding, recirculation of the furnace gases through the heating chamber is required. This is accomplished in the manner that has been described above. In carburizing or recarburizing, a hydrocarbon gas is introduced into hollow block 8 through passage 10. For dry cyaniding, a hydrocarbon gas and ammonia are introduced, while for nitriding, only ammonia is used.

It will be seen that many different heat treating operations can be accomplished with this apparatus, and that work can be transferred horizontally and vertically between the different chambers and tanks without exposing it to the outside atmosphere. Operations that are possible with this apparatus include the following: dry cyaniding, brazing, austempering, martempering, drawing and tempering, nitriding, hardening, high speed hardening, age hardening, case hardening, annealing, cycle annealing, spheroidizing, carburizing, recarburizing, normalizing, oil tempering and solution heat treating.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. Universal heat treating apparatus, comprising a furnace with a doorway, a cooling chamber with a doorway, a vestibule forming a closed passage connecting said doorways, doors for said doorways, a roller conveyor in the vestibule for conveying work from the furnace to the cooling chamber, sprockets mounted on the ends of the conveyor rollers, an endless driving chain normally meshing with the tops of all of said sprockets for turning the rollers, an open top tank below said conveyor, a group of the conveyor rollers above the tank being movable as a unit downward into it, and means for moving said group of rollers downward away from said chain to lower work into the tank.

2. Universal heat treating apparatus, comprising a furnace with a doorway, a cooling chamber with a doorway, a vestibule forming a closed passage connecting said doorways, doors for said doorways, a roller conveyor in the vestibule for conveying work from the furnace to the cooling chamber, the top of the conveyor being above the level of the bottoms of the doors, means for raising said doors, bridges below said doors and elevated with said raising means for bridging the space previously occupied by the doors substantially at the level of the top of said conveyor, an open top tank below said conveyor, a group of the conveyor rollers above the tank being movable as a unit downward into it, and means for moving said group of rollers vertically.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

1,073,235	Hillebrand	Sept. 16, 1913
1,168,313	Kenworthy	Jan. 18, 1916
1,818,759	Schrumm	Aug. 11, 1931
1,888,960	Talley	Nov. 22, 1932
1,979,108	Ipsen	Oct. 30, 1934
2,223,603	Darrah	Dec. 3, 1940
2,254,047	Roth	Aug. 26, 1941
2,349,679	Roth	May 23, 1944
2,438,064	Loux	Mar. 16, 1948
2,589,811	Holcroft	Mar. 18, 1952

2,639,047	Ipsen	May 19, 1953
2,639,138	Dow	May 19, 1953

FOREIGN PATENTS

18,082	Great Britain	1912

OTHER REFERENCES

"New Batch Type Gas Cyaniding Furnace" found in Metal Progress, vol. 52, December 1947, pages 584–587.

"Bright Hardening etc." found in Metal Progress, vol. 59, February 1951, pages 232–238, only pages 235, 236 relied on.