Aug. 12, 1958 V. H. FERGUSON 2,847,203

HEAT TREATING APPARATUS

Filed April 30, 1956 3 Sheets-Sheet 1

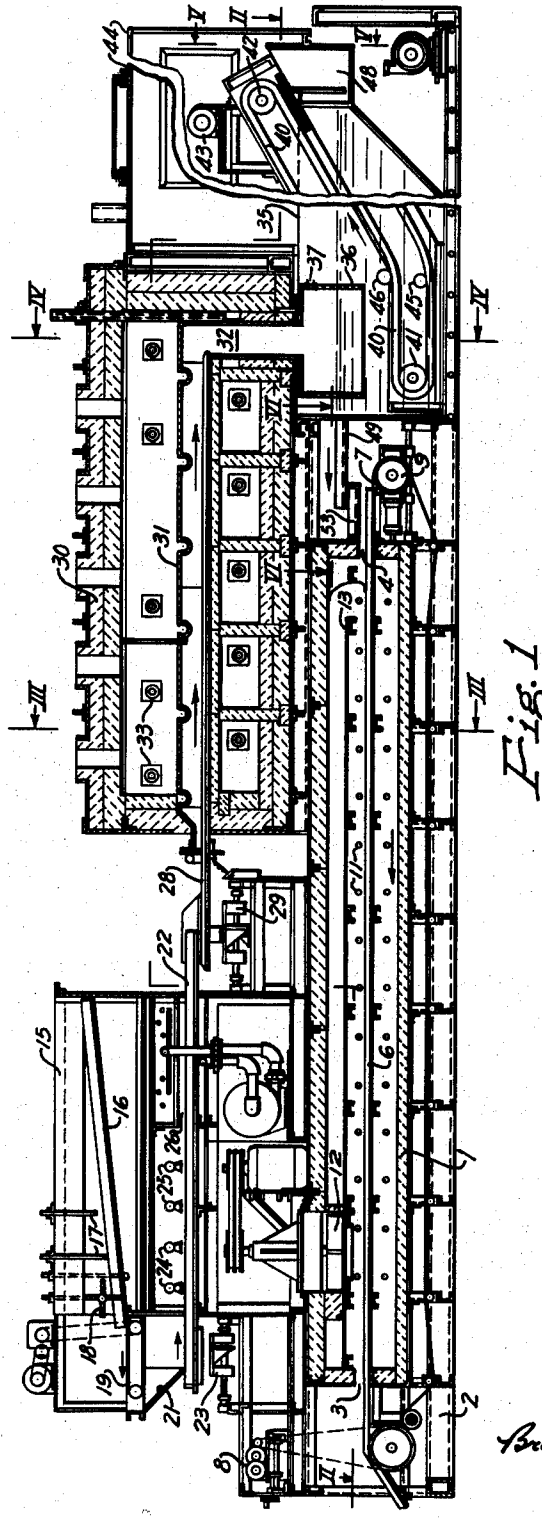


Fig. 1

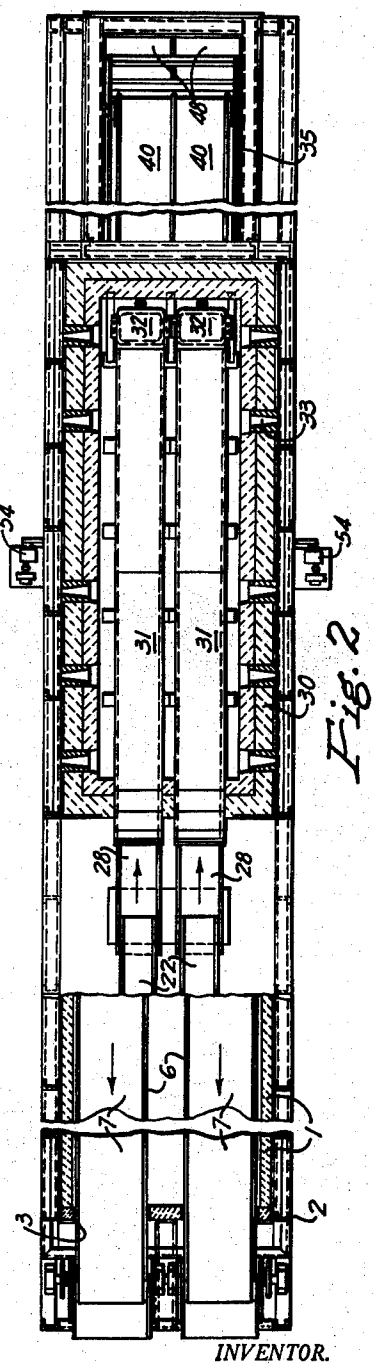


Fig. 2

INVENTOR.

VERNON H. FERGUSON

BY

Brown, Critchlow, Flick & Peckham

HIS ATTORNEYS

Aug. 12, 1958 V. H. FERGUSON 2,847,203

HEAT TREATING APPARATUS

Filed April 30, 1956 3 Sheets-Sheet 2

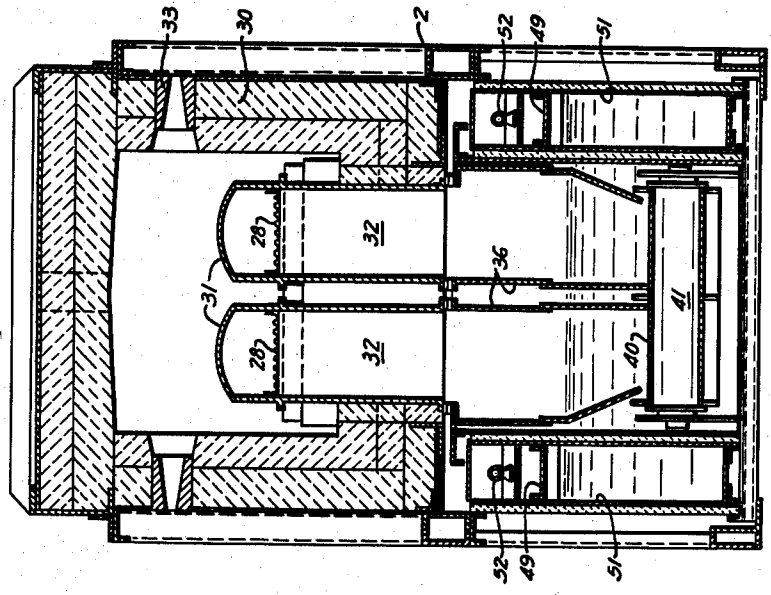


Fig. 4

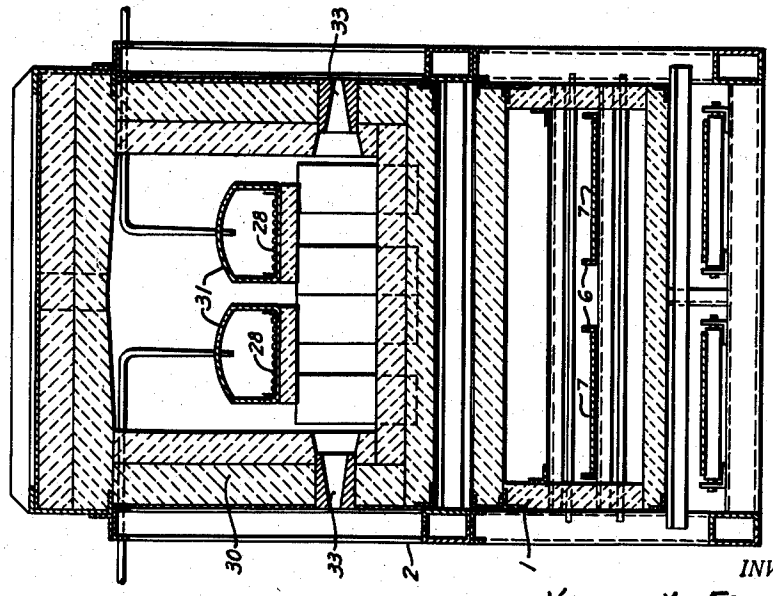


Fig. 3

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

Aug. 12, 1958 V. H. FERGUSON 2,847,203

HEAT TREATING APPARATUS

Filed April 30, 1956 3 Sheets-Sheet 3

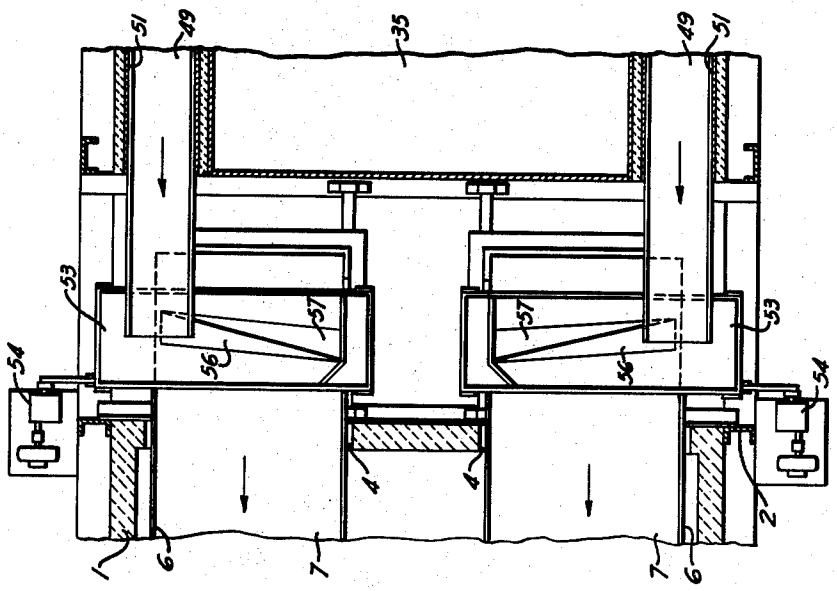


Fig. 6

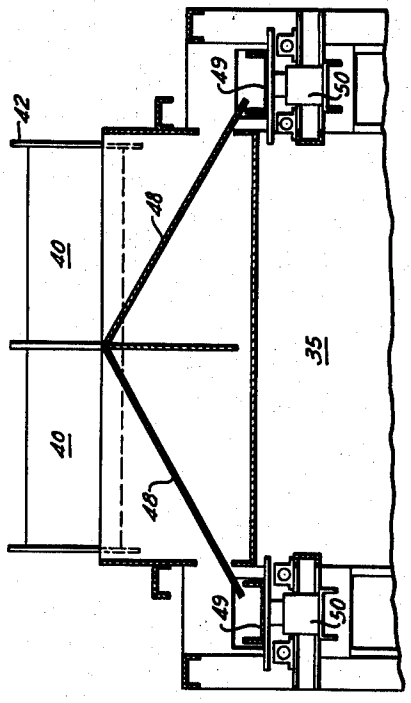


Fig. 5

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

United States Patent Office 2,847,203 Patented Aug. 12, 1958

2,847,203

HEAT TREATING APPARATUS

Vernon H. Ferguson, Pittsburgh, Pa.

Application April 30, 1956, Serial No. 581,727

3 Claims. (Cl. 266—4)

This invention relates to heat treating apparatus for metal articles, and more particularly to apparatus for performing a complete heat treating operation automatically.

It is among the objects of this invention to provide such apparatus which can be shipped and installed as a complete compact unit ready to operate when connected to utilities, which can easily be moved from one location to another, which requires a minimum of floor area and vertical space, which is of substantially uniform width from end to end, which can be loaded and unloaded from the same end, and which permits a plurality of groups of different types of articles to be heat treated simultaneously without mixing.

In accordance with this invention, a lower tempering furnace is loaded at its rear end and discharges heated articles from its front end. A conveyor extends forward through the furnace to convey the articles therethrough. Mounted on top of the lower furnace is a hardening furnace, which is loaded at its front end and has a discharge opening at its rear end behind the lower furnace. A conveyor extends rearwardly through the upper furnace. Also mounted on the lower furnace in front of the upper furnace is apparatus for automatically feeding the articles to be heat treated to washing, rinsing and drying means before they enter the upper furnace. Disposed behind the lower furnace, below the discharge end of the upper furnace, is a quenching tank in position to receive heated articles discharged from the upper furnace. A conveyor in this tank carries the articles back through it and out of its rear end, where they are delivered to the rear ends of a pair of conveyors extending forward along the opposite sides of the tank. Each of these last-mentioned conveyors extends through a washing tank where the quenched articles are cleaned. Between the quenching tank and the lower furnace, there are transverse conveyors which connect the front ends of the cleaning tank conveyors with the lower furnace conveyor so that the articles will ultimately be discharged from the front end of the lower furnace. It will be seen that after the articles are delivered to the loading mechanism, they are automatically carried through this entire heat treating operation and discharged at the front end of the apparatus.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a longitudinal vertical section through the apparatus;

Fig. 2 is a horizontal section taken on the line II—II of Fig. 1;

Figs. 3 and 4 are transverse sections taken on the lines III—III and IV—IV, respectively, of Fig. 1;

Fig. 5 is an enlarged transverse section taken on the line V—V of Fig. 1; and

Fig. 6 is an enlarged fragmentary horizontal section taken on the line VI—VI of Fig. 1.

Referring to the drawings, a tunnel type tempering furnace 1 is mounted in the lower part of a structural steel framework 2 that is rectangular in plan view, as shown in Fig. 2. This furnace has an exit 3 at the front end of the apparatus and a loading entrance 4 at the rear end. A conveyor of any suitable form is provided for transporting articles forward through the furnace. For example, extending through the furnace and its entrance and exit openings, there may be a pair of parallel horizontal channels 6, each of which supports an endless conveyor belt 7 of metal mesh. The belts are moved forward through the furnace by any suitable driving mechanism 8 supported in the front part of framework 1. The lower lengths of the belts travel back beneath the furnace and up around takeup drum 9 mounted in the framework a short distance behind the furnace. The inside of the furnace is heated in any convenient manner, such as by electric heaters 11. An electric blower 12 inside the front part of the furnace near its roof, draws the furnace atmosphere up to the roof and then forces it back through a duct 13 to the back of the furnace for recirculation.

Mounted above the front portion of the tempering furnace, as shown in Fig. 1 is a feeder for feeding metal articles into this apparatus. When two conveyor belts are used in the furnace, the feeder includes two parallel hoppers 15 provided with forwardly and downwardly inclined bottoms 16 and vertically adjustable article-control gates 17. Near the lower end of each hopper bottom, there is a paddle wheel 18 that helps to discharge the articles, which have been deposited in the hopper, onto a forwardly moving metering belt 19. The belt dumps the articles onto short slides 21 that feed them back to the front ends of a pair of parallel conveyors 22, such as shuffle trays, which extend rearwardly below the hoppers and project from their rear ends. These trays, which are perforated, are reciprocated by suitable means 23 below them. As the articles start back beneath the hopper, they are first washed by spray nozzles 24 and then rinsed by other nozzles 25, and then they pass through a drying chamber 26 where heated air is blown against them to dry them.

The rear ends of shuffle trays 22 empty onto the front ends of another pair of conveyors, which may be shuffle trays 28 reciprocated by suitable reciprocating mechanism 29 mounted on the central portion of the tempering furnace. These last conveyor trays extend back into a tunnel type hardening furnace 30, the front half of which is disposed directly above the rear portion of the tempering furnace and practically rest on it. The upper furnace extends a considerable distance behind the lower furnace, and has an exit at its rear end preferably extending down through the bottom of the furnace. The trays 28 are moved at varying rates of speed, depending on the general nature of the articles thereon, to cause those articles to move toward the back of the furnace. The trays may be covered by separate muffles 31, the inner or rear ends of which terminate at the upper ends of a pair of chutes 32 that extend down through the furnace exit. The furnace is heated in any suitable way, such as by gas burners (not shown) connected to burner blocks 33 in the side

walls of the furnace. If electric heating, for example, is used, it would not be necessary to employ muffles.

The lower ends of the two chutes empty into the front portion of a quenching tank 35 spaced behind the rear end of the lower furnace. The tank extends behind the upper furnace and is kept nearly full of quenching liquid. A hood 36 surrounds the lower end of each chute and extends down into the liquid. The hoods are considerably larger than the chutes. The reason for providing these hoods or enlargements for the lower ends of the chutes, is to greatly minimize splashing of the oil up the chutes into the furnace when the articles fall into the quenching tank. Such splashed oil forms carbon deposits and, by cooling only isolated areas of the hot articles, is likely to deform them. The large hoods also provide large areas for accumulation of the gases that are formed when the hot articles strike the oil. Between the time that a group of the articles falls off the end of a shuffle tray and the time that the next group is fed forward into the chute, the gases are withdrawn from the hood through an opening 37 near its top, and therefore do not rise into the furnace. These gases would be harmful if allowed to rise up into the chutes, because they contain carbon particles that form deposits. Such gases would also affect the work in the furnace chamber, causing slightly irregular surface conditions on the work pieces, which appear to cause additional distortion when the work is quenched, due to slightly different quenching rates.

When the articles heated in the upper furnace reach the rear ends of the conveyor therein, they fall through the chutes and hoods into the liquid in the quenching tank and land on a conveyor. This conveyor preferably is composed of a pair of endless mesh belts 40 that pass around a drum 41 journaled in the front part of the tank and also around a driving drum 42 mounted above the back wall of the tank. This upper drum is rotated by drive mechanism 43 mounted above the tank in a housing 44 that separates the tank from the outside atmosphere. A length of each belt is maintained horizontal in the tank by means of small drum 45 that engages the top of the lower portion of the belt, and by means of small rollers 46 that engage the top of the belt at its opposite sides.

The quenched articles fall off the upper or rear end of the tank conveyor and onto chutes 48 that are inclined laterally toward the opposite sides of the apparatus. The lower ends of these chutes empty onto the rear ends of shuffle type conveyors 49 that extend forward along the opposite sides of the quenching tank. These conveyors, which have perforated bottoms, are reciprocated by suitable mechanisms 50. Each conveyor is located in the upper part of a narrow cleaning tank 51 that extends along one side of the quenching tank, and a spray pipe 52 extends along the top of the conveyor. These pipes wash and rinse the quenched articles as they move forward along the shuffle conveyors. The conveyors extend forward beyond the tanks a short distance, and each terminates above a short transverse conveyor in the form of a tray 53 that is vibrated lengthwise by suitable means 54 beside the apparatus, as shown in Fig. 6. Each of these transverse conveyor trays extends across the rear end of one of the conveyor belts 7 in the lower furnace. The bottom of the tray is provided with a rectangular opening, but this opening is generally partly closed by an adjustable plate 56 so that the remaining slot 57 therethrough is triangular and flares out from a point below the adjacent cleaning tank conveyor toward the inner end of the transverse conveyor. This general shape of slot assures substantially uniform feeding of the articles across the lower furnace belt. As the quenched articles travel forward through the lower furnace, they are tempered and finally are discharged from the front end of the furnace.

It will be seen that with this apparatus only one attendant is required, who can look after several of these units. He can stand at the front of the apparatus and watch the feeding of articles to the first washing unit and the delivery of the heat treated articles from the lower furnace. As everything is enclosed, a controlled atmosphere throughout the apparatus or at any desired location therein is possible. By placing the feeding and first washing apparatus and the hardening furnace above the tempering furnace and the quenching tank, considerable floor space is saved and the apparatus is made very compact. Yet, its height is low, which makes it possible for all processes to be observed from floor level by a single operator. It will be noted that the combined width of the quenching tank and the cleaning tanks beside it is no greater than the width of the rest of the apparatus, because the cleaning tank conveyors extend forward below the upper furnace. Consequently, this apparatus can have the same uniform width from front to back, thereby making it easy to fit into a plant, or onto railroad cars for shipment. The cleaning tank conveyors and the transverse conveyors to which they deliver have no effect on the height of the apparatus. It will be observed that this apparatus performs six consecutive operations, all entirely automatically. They are automatic loading, prewashing and drying, hardening, oil quenching, washing and drying, and tempering.

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 the best embodiments. 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. Heat treating apparatus for metal articles, comprising a lower furnace having a loading rear end and a discharge front end, a conveyor extending forward through the furnace, an upper furnace mounted on the lower furnace and having a loading front end and having a discharge rear end projecting behind the lower furnace, a conveyor extending rearwardly in the upper furnace, a quenching tank disposed behind and at substantially the same level as the lower furnace and below the discharge end of the upper furnace in position to receive heated articles discharged from the upper furnace, a conveyor in the tank adapted to carry said articles back through the tank and out its rear end, a cleaning tank extending along each side of the quenching tank, a conveyor extending forward through each cleaning tank, conveyor means connecting the rear end of the quenching tank conveyor with the rear ends of the cleaning tank conveyors, and transverse conveyors located between the quenching tank and lower furnace and connecting the front ends of the cleaning tank conveyors with the lower furnace conveyor at its loading end, whereby said articles will be discharged from the front end of the lower furnace.

2. Heat treating apparatus according to claim 1, in which the combined width of the quenching and cleaning tanks is substantially the same as the width of the upper furnace, and said cleaning tank conveyors extend beneath the upper furnace.

3. Heat treating apparatus for metal articles, comprising a lower furnace having a loading rear end and a discharge front end, a conveyor extending forward through the furnace, an upper furnace mounted on the lower furnace and having a loading front end and having a discharge rear end projecting behind the lower furnace, a conveyor extending rearwardly in the upper furnace, a quenching tank disposed behind and at substantially the same level as the lower furnace and below the discharge end of the upper furnace in position to receive heated articles discharged from the upper furnace, a conveyor in the tank adapted to carry said articles back through the tank and out its rear end, a cleaning tank extending along each side of the quenching tank, a conveyor extending forward through each cleaning tank,

conveyor means connecting the rear end of the quenching tank conveyor with the rear ends of the cleaning tank conveyors, a pair of transverse conveyors located between the quenching tank and lower furnace in positions to receive articles near their outer ends from the front ends of said cleaning tank conveyors, and means for reciprocating the transverse conveyors transversely of the cleaning tank conveyors, each of said transverse conveyors being provided in its bottom with a slot tapering from a point near the inner end of the conveyor to a point near its outer end, said slot being located above the loading end of the lower furnace conveyor for distributing said articles across the furnace conveyor.

References Cited in the file of this patent

UNITED STATES PATENTS

1,668,164	McCann	May 1, 1928
1,697,129	McCann	Jan. 1, 1929
1,859,803	Shanafelt et al.	May 24, 1932
1,949,438	Webb	Mar. 6, 1934
2,074,185	Langhammer et al.	Mar. 16, 1937
2,223,603	Darrah	Dec. 3, 1940
2,254,913	Roth	Sept. 2, 1941
2,438,064	Loux	Mar. 16, 1948
2,682,332	Isbell	June 29, 1954