

[54] **CONTINUOUS ANNEALING FACILITIES FOR DRAWING STEEL STRIP**

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[51] Int. Cl. .... **C21d 1/64**

[58] Field of Search ..... **266/3, 45; 34/62; 165/65, 120; 134/104, 109; 148/156**

[56] **References Cited**

**UNITED STATES PATENTS**

|           |         |                  |            |
|-----------|---------|------------------|------------|
| 2,768,916 | 10/1956 | Seabold et al.   | 266/3 R X  |
| 2,797,177 | 6/1957  | Keller           | 266/3 R X  |
| 2,890,878 | 6/1959  | Steinherz et al. | 266/3 R    |
| 2,892,744 | 6/1959  | Myers            | 266/3 R X  |
| 2,991,989 | 7/1961  | Martin           | 266/3 R UX |
| 3,194,545 | 7/1965  | Smith            | 266/3 R    |

|           |        |             |           |
|-----------|--------|-------------|-----------|
| 2,205,915 | 6/1940 | Wean et al. | 148/156   |
| 2,585,277 | 2/1952 | Seabold     | 148/156 X |

**OTHER PUBLICATIONS**

Blast Furnace And Steel Plant, Sept. 1957. TS300.B6. Pp. 1024 & 1025.

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[57] **ABSTRACT**

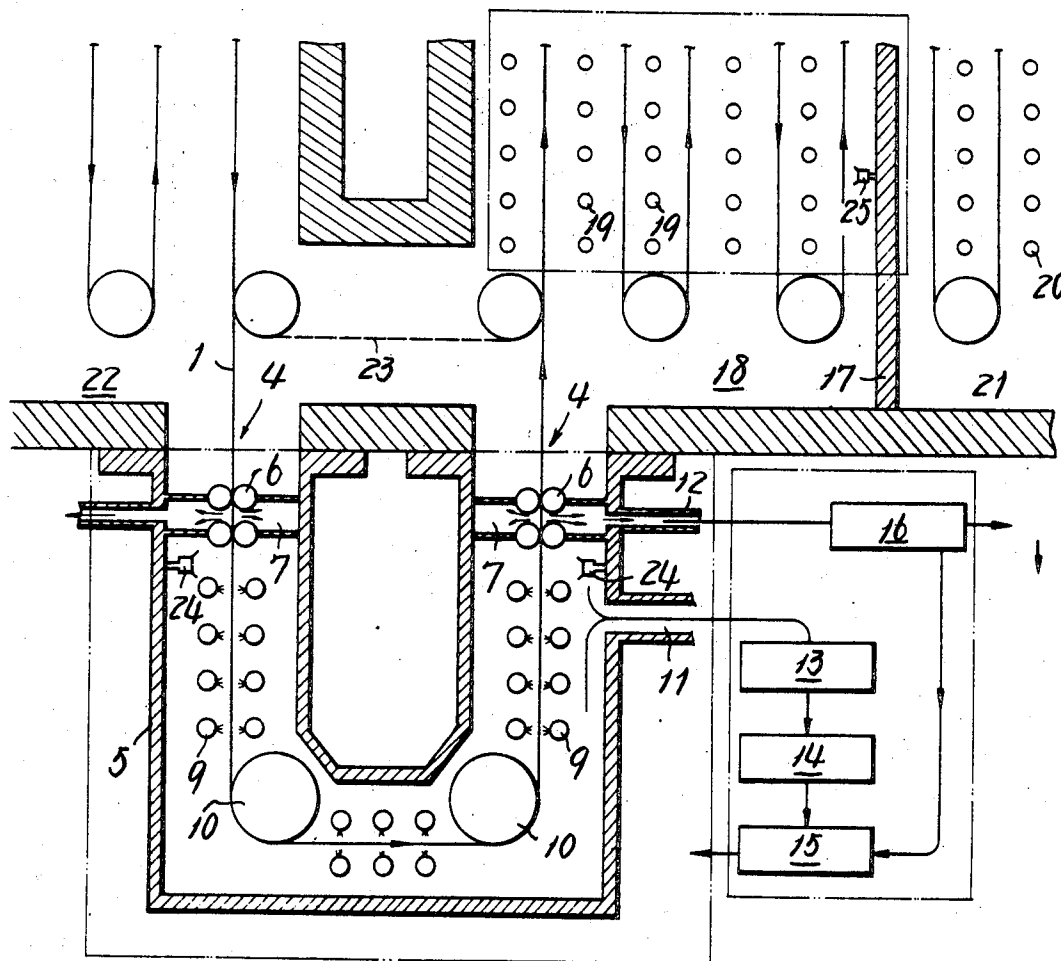
A continuous annealing facilities substantially comprising the following devices:

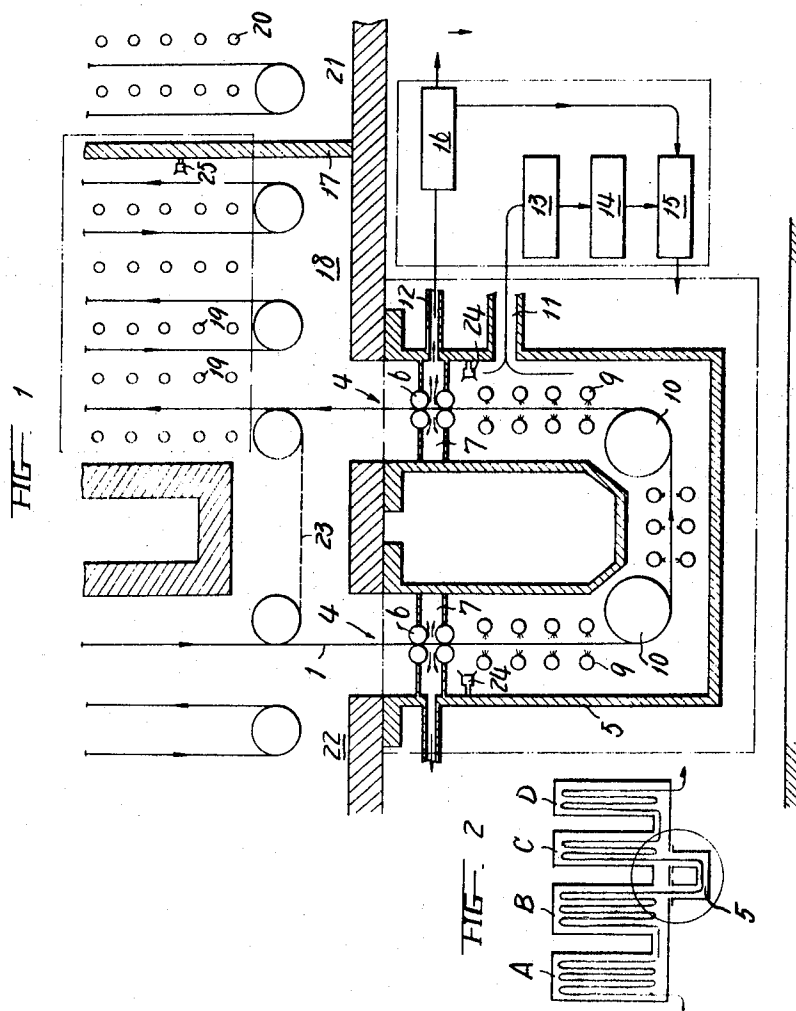
heating and soaking zones that the temperature of passing strip is within the range of 710° to 800° C, a rapid cooling chamber that the cooling rate of said strip is more than 50° C per second from 300° to 500° C

a shelf treating zone that said strip is possible to maintain at the temperature of said 300° to 500° C for at least 10 seconds, and

a cooling zone that the strip is cooled to room temperature.

**1 Claim, 2 Drawing Figures**





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## CONTINUOUS ANNEALING FACILITIES FOR DRAWING STEEL STRIP

This invention relates to a novel continuous annealing apparatus which is particularly useful for obtaining good drawability of steel sheet.

There are many circumstances in which it is desirable to obtain good drawability of steel sheet by a continuous annealing process. This is based on the fact that productivity of said continuous annealing process is much higher than that of the conventional annealing furnace e.g., tight coil or open coil annealing furnace. However, common continuous annealing furnaces having high productivity, which cannot be compared with the above furnaces, are for obtaining hard steel, e.g., tin plate. It is well-known that a steel produced by said continuous annealing process is unsuitable for press-forming services.

This invention is developed to comply with said desires. The features thereof lie in an arrangement in which a rapid cooling chamber and a shelf treating zone are provided between a heating zone and a cooling zone in the ordinary continuous annealing facilities.

An object of this invention is to provide a novel and improved continuous annealing apparatus which is particularly useful for obtaining good drawability of steel sheet.

Another object of this invention is to provide a novel and improved continuous annealing apparatus having a high productivity which can not bear comparison with the ordinary batch type or open coil annealing furnace for deep-drawing steel sheet.

A further object of this invention is to provide a novel and improved continuous annealing apparatus having entirely uniform mechanical properties in which it is possible to make a steel sheet having entirely uniform mechanical properties which is extending over the whole length and width of steel strip. Such a steel could not be made by said batch type or open coil annealing furnace.

Other object and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawing in which:

FIG. 1 is an enlarged vertical sectional view of a portion of the present apparatus facilities shown in, and

FIG. 2 is a schematic diagram of a portion of a continuous annealing line, which is this invention.

Referring now to FIG. 2, A shows a heating zone; B, a soaking zone; C, a shelf treating zone; and D, a cooling zone. 5 is a rapid cooling chamber. Such facilities are evidently different from the ordinary continuous annealing furnace. That is, the rapid cooling chamber and shelf treating chambers are main devices in this invention. The rapid cooling rate in said chamber 5 should be more than 50° C per second. According to many experiments, it is confirmed that the greater said rapid cooling rate is, the greater is the drawability of the steel. A desirable heating temperature at starting point of said rapid cooling is within the range of 710° C from 800° C. In other words, such a rapid cooling rate as carbide is impossible to be precipitated while cooling is needed. Said shelf treating temperature is 300° to 500° C and shelf treating time is more than 10 seconds. When steel strip is treated as mentioned above, a steel sheet having good drawability is obtained with ease, which is entirely uniform extending over the whole length and width of said strip.

FIG. 1 is an embodiment of said rapid cooling chamber 5 shown in FIG. 2. In said chamber 5 water, oils such as light oil, lump oil and sealing oil, low grade alcohol such as ethanol, methanol and propanol, refrigerants such as ammonia and freon and liquefied gas such as liquid nitrogen is possible to be employed as the coolant respectively. Both latent heat and sensible heat of such coolants are high. Accordingly, cooling efficiency is very good. It is needless to say that these cooling agents do not compound with the steel, do not remain on the surface of the steel and are harmless to men.

In general, steel strip 1 is passed through from soaking zone 22 to slow cooling zone 18 along an imaginary line 23. In this invention, a rapid cooling chamber 5 is arranged, and simultaneously said slow cooling zone 18 is controlled to hold at a constant temperature, i.e., 300° to 500° C, for at least ten seconds. The entry side and delivery side of said rapid cooling chamber 5 should be sealed respectively. That is, sealing portion 7 and seal roll 6 are provided. Steel strip 1 is passed through said chamber 5 by openings 4 and over guide rollers 10. Many groups of spray nozzle 9 are provided on both sides and extend over the whole width of said strip 1.

Internal pressure of said chamber 5 should be maintained at a lower degree than that of said soaking zone 23 and shelf treating zone 18. If not so, cooled atmosphere in said chamber 5 flows into said soaking zone 22 or shelf treating zone 18, consequently, said heat treating in these zone will be spoiled. For this reason, the atmosphere gas in sealing portion 7 is absorbed by a pump 16 through exhaust pipe 12 and then is liquidized and is returned to a storage tank 15 of said coolant. In such a case, a part of said atmosphere gas in absorption pump 16 is returned to said furnace. On the other hand, said coolant after cooling in said chamber 5 is absorbed by a blower 13 and then is liquidized by heat exchanger 14 and is returned to said tank 15. Said coolant in said tank 15 is sprayed from said nozzles 9. Rapid cooling of the strip goes on. Numeral 24 is an indicator of the temperature in said chamber 5.

It is, in general, well-known that the atmosphere is fed into pipes 19 of slow cooling zone 18 as the slow cooling means. However, in this invention, the exhaust gas from said heating zone 22 is fed into said pipe 19 in place of the atmosphere. Thus, said shelf treating of steel strip is possible to be carried out with ease. If an existing slow cooling zone is employed as a shelf treating zone, it is enough to divide said zone into two portion, i.e., portions 18 and 21 by screen plate 17. In such a case, zone portion 18 is employed as a shelf treating zone and zone portion 21 is employed as an ordinary slow cooling zone. Numeral 20 shows a feeding pipe of the atmosphere for slow cooling. Numeral 25 is an indicator of the temperature in said shelf treating zone 18.

When the continuous annealing facilities as mentioned above is employed, steel sheet having good drawability is possible to be made with ease and stably.

What is claimed is:

1. A continuous annealing apparatus comprising a chamber having a heating zone, a soaking zone, a rapid cooling chamber, a shelf treating zone and a cooling zone, and means for moving strip steel from said heating zone to said soaking zone to said rapid cooling chamber to said shelf treating zone and then to said cooling zone for obtaining steel sheet of good drawability, means sealing said rapid cooling chamber from said zones, but permitting the passage of said steel strip, means for introducing a coolant to said rapid cooling chamber, gas absorbing devices connected to said sealing means and coolant recovery means connected to said rapid cooling chamber.

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