Aug. 7, 1945. S. J. DISHAUZI 2,381,652

CONTINUOUS STRIP PICKLING

Original Filed July 24, 1941

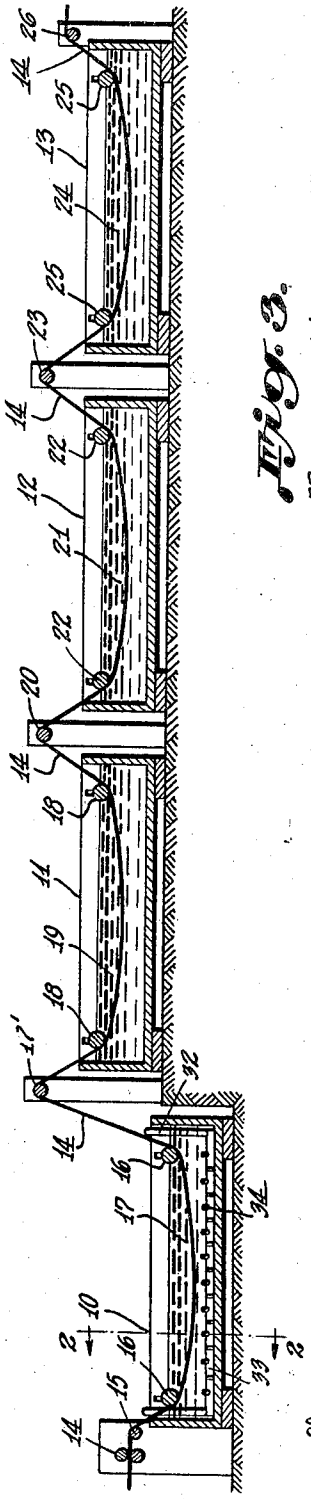


Fig. 1.

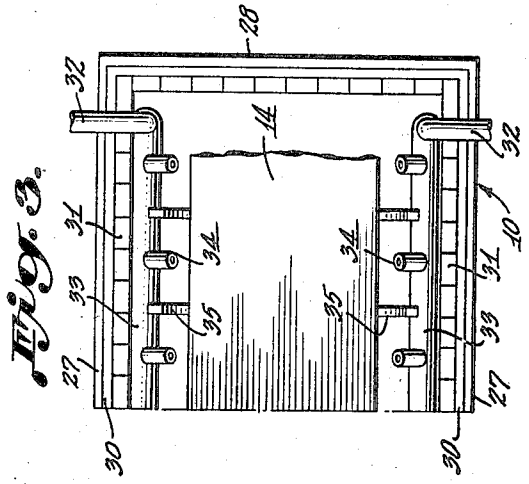


Fig. 3.

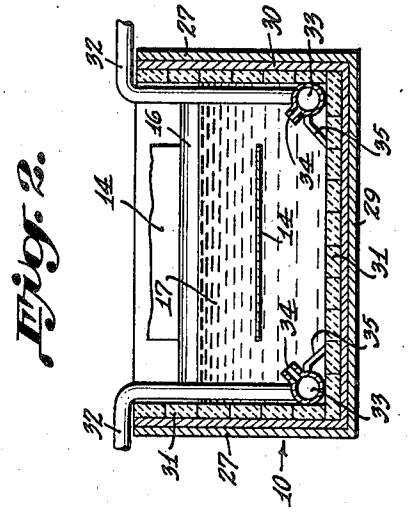


Fig. 2.

Inventor

STEVE J. DISHAUZI

By James J. Shanley

Attorney

Patented Aug. 7, 1945 2,381,652

UNITED STATES PATENT OFFICE

2,381,652

CONTINUOUS STRIP PICKLING

Steve J. Dishauzi, Hollidays Cove, W. Va., assignor to National Steel Corporation, a corporation of Delaware

Original application July 24, 1941, Serial No. 403,902. Divided and this application November 11, 1943, Serial No. 509,893

1 Claim. (Cl. 266—7)

This invention relates to an improved continuous pickling method and apparatus for strip metal to attain higher speed of the strip while maintaining satisfactory pickling.

Continuous pickling of strip metal is old. In the systems of the prior art the strip was passed through a series of tanks containing pickling solution, the process being stopped when the pickling solution was to be renewed. United States Patent No. 2,166,583 to Critten discloses an improved process in which pickling of the strip continues while one tank of pickling solution is being renewed. In order to accomplish this purpose, the waste pickling solution from one of the tanks is transferred to an empty tank through which the strip has been running, and a fresh pickling solution is mixed in the tank from which the waste pickling solution was transferred. The present invention is an improvement over that shown in the patent.

The greatest action of the pickling solution takes place in the first tank contacted by the strip. Here the acid of the pickling solution attacks the oxide on the metal with the greatest vigor. As a result a partially spent pickling solution in this tank can perform a proportion of the pickling comparable to that performed in each of the following tanks containing fresher solution. On the other hand, a fresh pickling solution in this tank would attack the strip with such vigor that the solution would soon be spent. This would put no burden on the subsequent tanks at first but would throw the burden on these tanks as the solution in the first tank became spent. The solution in the second tank would then heavily attack the metal after the solution in the first tank was spent. Recharging the first tank with fresh pickling solution would again cause the heavy reaction to be transferred to this tank. When the tanks subsequent to the first tank contained fresh solution, the heavy reaction in the first tank would result in overpickling by the fresh solution in the subsequent tanks. When the reaction in the first tank fell off sharply and the solution in the subsequent tanks was partially depleted, underpickling of the strip would result. Thus a sharp rise and fall of the pickling action would follow replenishing and depletion of the solution in the first tank.

To avoid this situation I have evolved a pickling method in which a partially spent pickling solution is charged to the first tank and the condition of the solution in this tank governs the replenishing of the subsequent tanks. The extent of the reaction in the first tank is thus maintained at a reduced level and the effect of using new pickling solution is minimized on the operation of the pickling line by such solution being used only in the subsequent tanks where it has less effect. A further result of this manner of operation is that the minimum speed of the strip is greatly increased. With a plurality of tanks in use and the condition of the solution in the first tank such as necessitates dumping, the speed of the strip is reduced as this tank is dumped. Since the waste solution being dumped was having a very slight pickling action on the strip, the reduction in speed of the strip at this point need be slight. With a solution which is only partially spent being transferred from a subsequent tank to the first tank, no further reduction in the speed of the strip is necessary. While the subsequent tank is being replenished the speed of the strip can be gradually raised to the maximum for obtaining satisfactory pickling. Thus, contrary to the systems of the prior art, at no time is a minimum number of tanks being used with one of the tanks having a spent solution therein.

In order to increase the pickling action of the partially spent solution in the first tank to a maximum, I have devised a system for circulating the solution using the heating medium. Due to the strip manufacturing process resulting in a hot rolled coil of strip, the center sections on both sides of the strip are not badly oxidized. The edges of the strip, however, being exposed in the coil, present heavily oxidized surfaces. By inducing a stream of the pickling solution to impinge upon the edge of the strip along its path through the tank, I have raised the action of the pickling solution at that point to a maximum.

This application is a division of copending application Serial No. 403,902 filed July 24, 1941 now Patent No. 2,334,177.

An important object of the present invention is the provision of a method of pickling continuous strip at a high rate of speed and with a minimum of speed reduction during recharging of the pickling solution.

Another important object of the present invention is the provision of apparatus for increasing the action of a pickling solution on the edges of hot rolled continuous strip.

Additional objects and advantages of my invention will become apparent in the following specification and claim.

In the accompanying drawing which forms a part of the present disclosure and in which like reference numerals designate like parts,

Figure 1 is a side elevation, partially in section,

of apparatus capable of carrying out the method of my invention.

Figure 2 is a cross-section taken on the line 2—2 of Figure 1, showing the pickling solution circulation system.

Figure 3 is a plan view of the tank of Figure 2.

Reference numerals 10, 11, 12 and 13 indicate pickling solution tanks arranged in series to form a pickling line. Tank 10 is situated at a lower level than the others to make possible gravitational flow of the pickling solution being transferred. Strip to be pickled is fed by power driven rolls 14 over guide roll 15 into tank 10. The strip passes under weighted rolls 16 located at each end of tank 10 and designed to maintain the strip under the surface of pickling solution 17. Strip 14 emerges from tank 10 and passes over guide roll 17' to tank 11 where it passes under weighted rolls 18 similar to roll 16 through pickling solution 19. Strip 14 emerges from tank 11 and goes over guide roll 20 into tank 12 wherein it is maintained under the surface of pickling solution 21 by weighted rolls 22. Strip 14 emerges from tank 12, goes over guide roller 23 and enters tank 13 wherein it is maintained under the surface of pickling solution 24 by weighted rollers 25. Strip 14 emerges from tank 13 and passes under guide roll 26 to further treatment and coiling not shown. Obviously rolls 16, 18, 22 and 25 could be omitted since gravity would cause the strip to hang in catenary form between the guide rolls 15, 17', 20, 23 and 26, thus to be guided through each tank.

Referring to Figures 2 and 3, tank 10 is shown as being comprised of steel side walls 27, end walls 28 and bottom 29. A liquid tight acid resistant lining 30 is bonded to the walls and bottom of tank 10. A protective lining 31 formed of acid resistant refractory bricks or the like is placed on the inside of the lining 30. Submerged in pickling solution 17 is the strip metal 14. Steam is used to maintain the pickling solution at the required temperature and steam supply pipes are shown at 32 entering the tank. These steam supply pipes connect with headers 33 which extend along the length of the tank adjacent the side walls and resting on the bottom. Each header 33 has a plurality of jets 34 which are directed at an angle of about 45° so that a stream of steam emitted therefrom will impinge upon the strip metal at its edge. Brackets 35 support header 33 against rotation due to the weight of the jets and the reaction of the stream of steam. Although this structure is shown applied to tank 10, the same heating and agitating system can be used in the other tanks.

With the system operating and the metal strip travelling through all the tanks, the action of the acid, preferably sulphuric acid, results in the formation of iron sulphate in the pickling solution. Since the oxide and other impurities on the metal strip are heaviest in tank 10, the action of the acid is greatest here. There would, therefore, be a more rapid production of iron sulphate in this tank where the initial pickling solution in each tank is the same. The operator of the pickling line observes the increase of iron sulphate in the pickling solution of each tank together with the reduction in concentration of acid. The proper concentration of acid is maintained in each tank, including the first tank, by the addition of acid. It has been found that an acid concentration of 25 to 30% in the first and second tanks, and somewhat lower in the others is satisfactory when treating low carbon hot rolled strip steel. The acid concentration in the first tank may be somewhat higher or may be substantially equal to that in the second tank. When the concentration of iron sulphate in the first tank exceeds about 30%, preparations may be initiated for dumping the solution. After this point is reached no more acid is added to the solution in the first tank so the acid content will approach 15 to 20% at time of dumping. Depending upon the extent of pickling desired and the speed of the strip metal, concentration of iron sulphate in this tank may be allowed to mount over 35%. When the iron sulphate concentration has reached the desired maximum point, the operator proceeds to dump the solution from this tank. Despite the high concentration of iron sulphate in the solution being dumped, some pickling action is present; therefore, with this tank emptying, the overall pickling action of the line is being reduced and the strip metal speed must be reduced slightly so that the increased pickling time will make up for the pickling action lost in tank 10. The operator then transfers the pickling solution from one of the subsequent tanks to the first tank, the subsequent tank chosen being that having the highest concentration of iron sulphate in the solution. A new batch of pickling solution is then prepared in the subsequent tank from which the solution was transferred, and the speed of the strip metal is simultaneously increased. The solution with the highest iron sulphate concentration is chosen to be transferred to the first tank because, as mentioned above, the action of the acid on the strip metal is considerably greater in this tank. Placing partially spent solution in this tank reduces this action somewhat and at the same time results in the most efficient use of the partially spent solution. The partially spent solution fortified by the addition of acid may be used for the major fraction of a day or more before the metal content becomes too high. Generally speaking, with the low carbon strip metal and a speed of the strip between 350 and 400 feet per minute, depending on the width of the strip, the concentration of iron sulphate in the first tank is allowed to reach 32 to 40% although a few percent one way or the other is not critical. While dumping the first tank the speed may be reduced to about 250 feet per minute. In such operations the subsequent tank having next highest concentration of iron sulphate will usually run between 10% and 20% iron sulphate. With strip 36 inches wide, I have found a speed of 375 feet per minute satisfactory and an iron sulphate concentration of about 38% the maximum desirable.

In order to obtain the most efficient action of the partially spent pickling solution in tank 10, I have devised the combined heating and agitating system which makes possible maximum speed of the strip metal with satisfactory pickling. This heating system maintains the solution in all the tanks at about 215° F. Headers 33 and jets 34 are arranged so that the stream of heating steam ejected into the pickling solution causes a stream of solution and steam to impinge on the edge portions of the strip metal. It is these portions that are not properly pickled when satisfactory pickling is not achieved. The hot rolled strip being coiled while still hot, only the edges of the strip are exposed to continued action of atmospheric oxygen to give a heavy oxide coating at this point. Previous jet systems which merely circulate the pickling solution do not give the

same satisfactory results as the present jet systems.

Due to the high temperature used in the present process and the high concentration of iron sulphate and free acid present in tank 10, the rate of pickling would be very low if it were not for applicant's improved agitating means. As the ferrous sulphate concentration approaches saturation, the ferrous sulphate being continually formed by the action of the acid, it will dissolve less readily in the solution and thus tend to remain on the surface of the strip, thereby reducing further action of the acid. Since most of the oxidation is present at the edges of the strip, this is where the salt would tend to collect. It is believed that the rapidly moving stream of solution and steam caused by jets 34 acts directly on this salt to brush the same off the surface of the strip to eliminate this difficulty.

I claim:

Apparatus for continuous pickling of strip metal comprising a tank for holding a body of pickling solution having a bottom, side walls and end walls, means adjacent the end walls to guide the strip metal through the body of pickling solution in the tank, a conduit extending along the inside of the tank, jets in the conduit directed towards points in the tank along which the adjacent edge of the strip metal travels, and a source of heating fluid connected to the conduit for supplying heating fluid to the jets under pressure so that heating fluid emitted from the jets causes a stream of the pickling solution to impinge on the strip metal.

STEVE J. DISHAUZI.