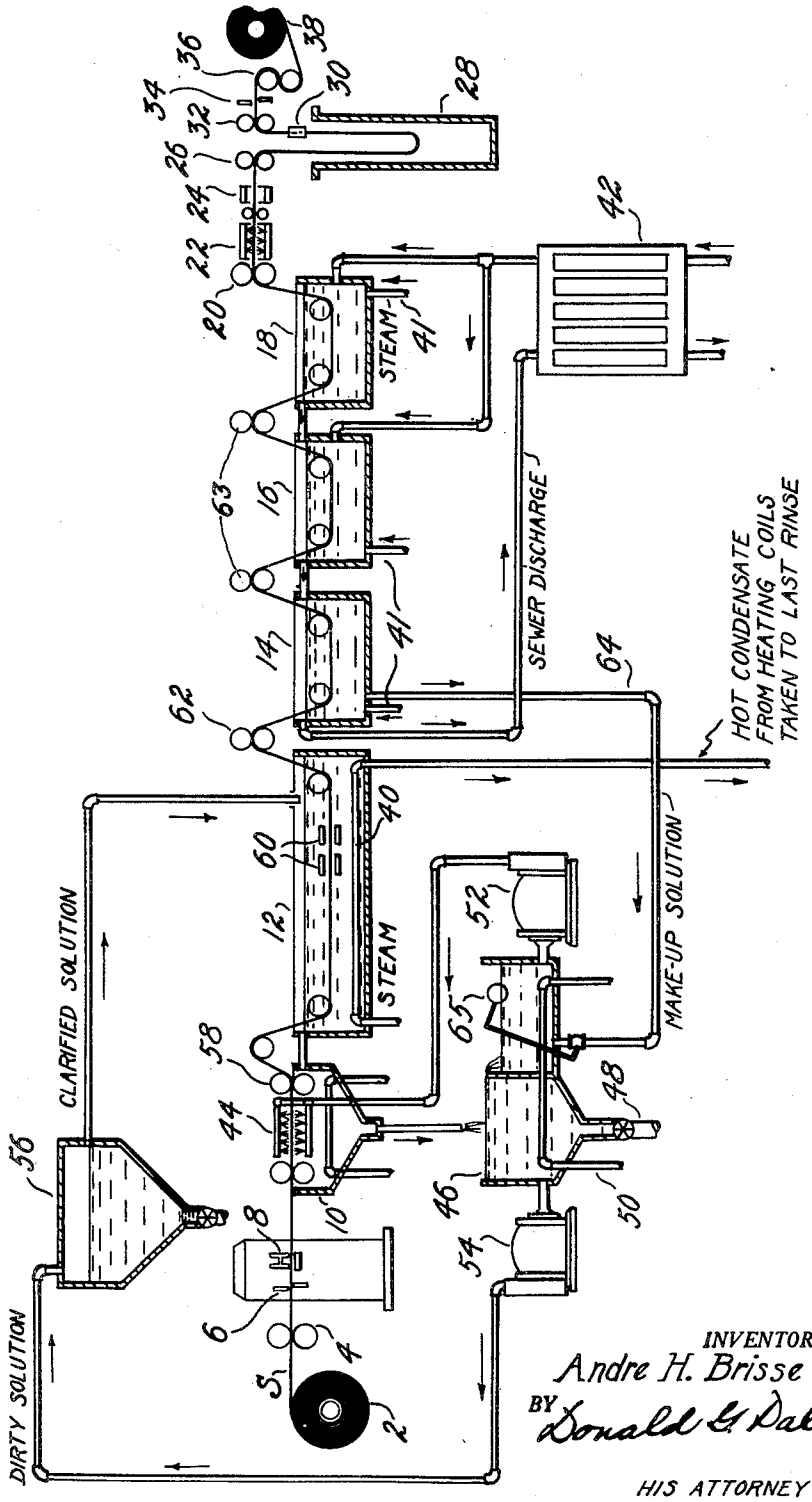
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METHOD AND APPARATUS FOR CONTINUOUS CLEANING OF METAL STRIPS

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Fig. 1.



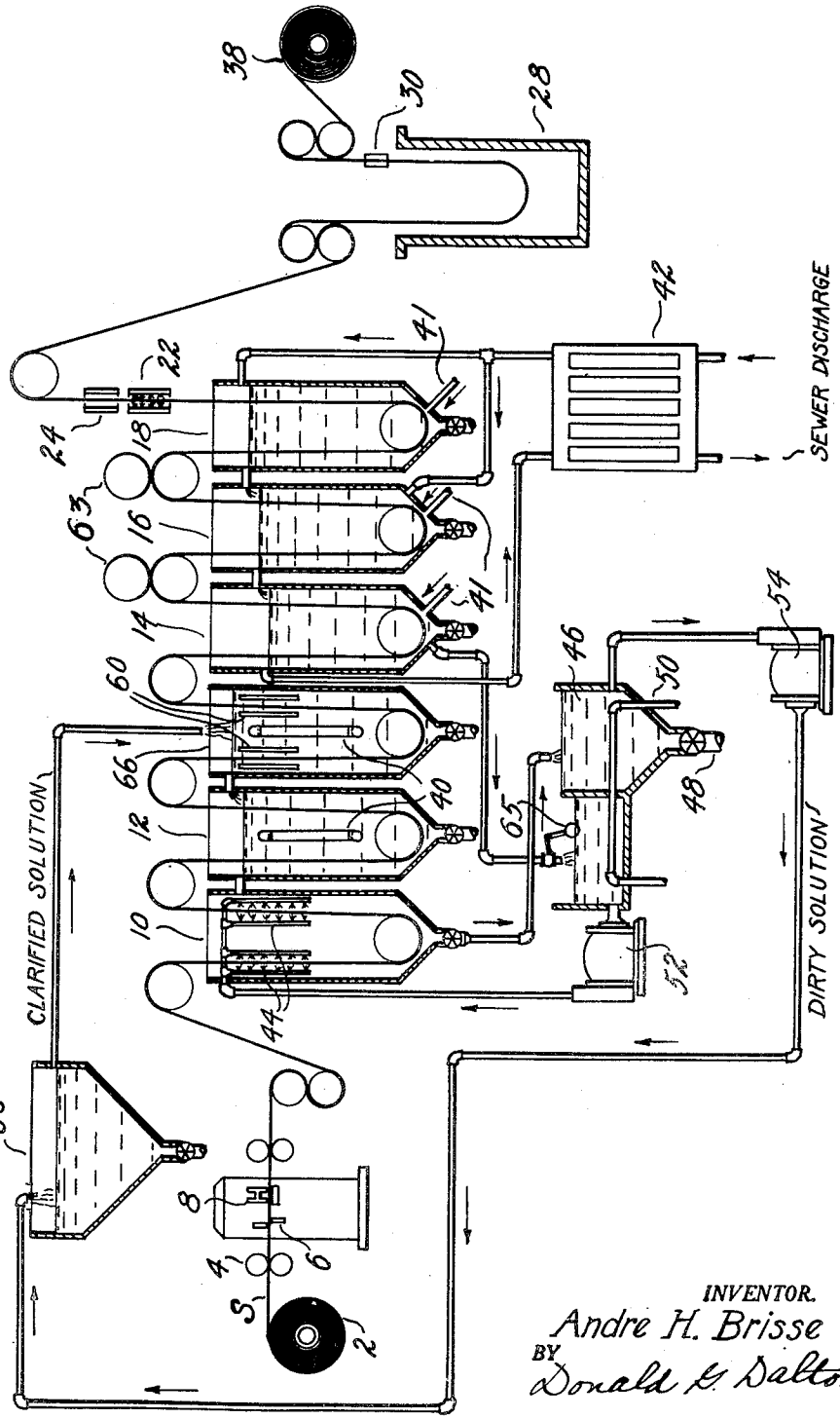
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METHOD AND APPARATUS FOR CONTINUOUS CLEANING OF METAL STRIPS

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Fig. 2.

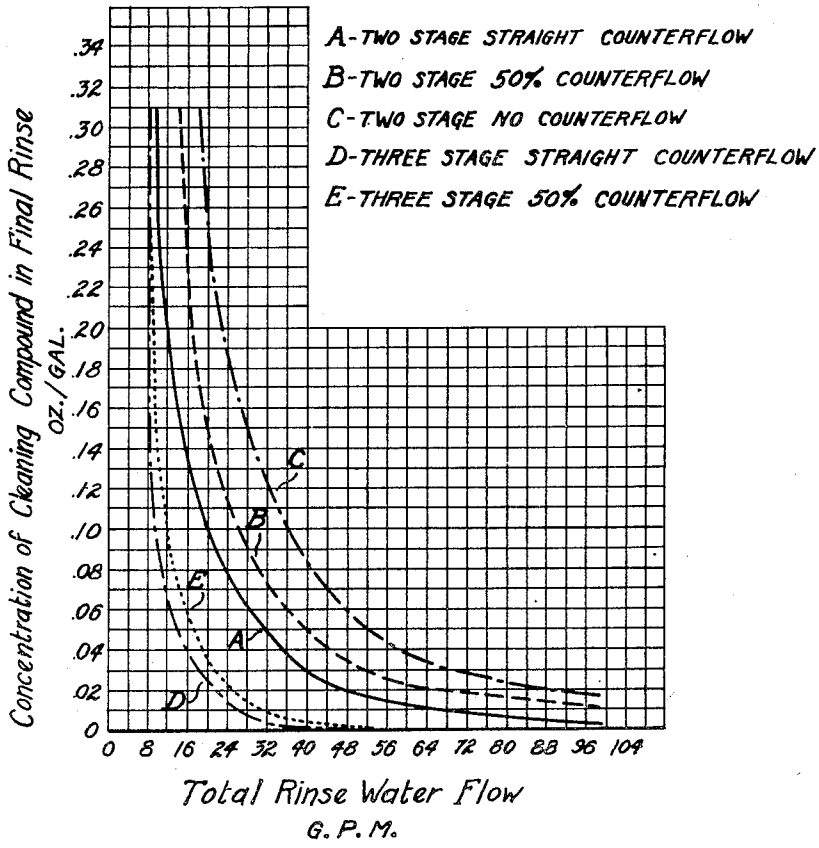


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Fig. 3.

Final Rinse Contamination
VS. Water Consumption

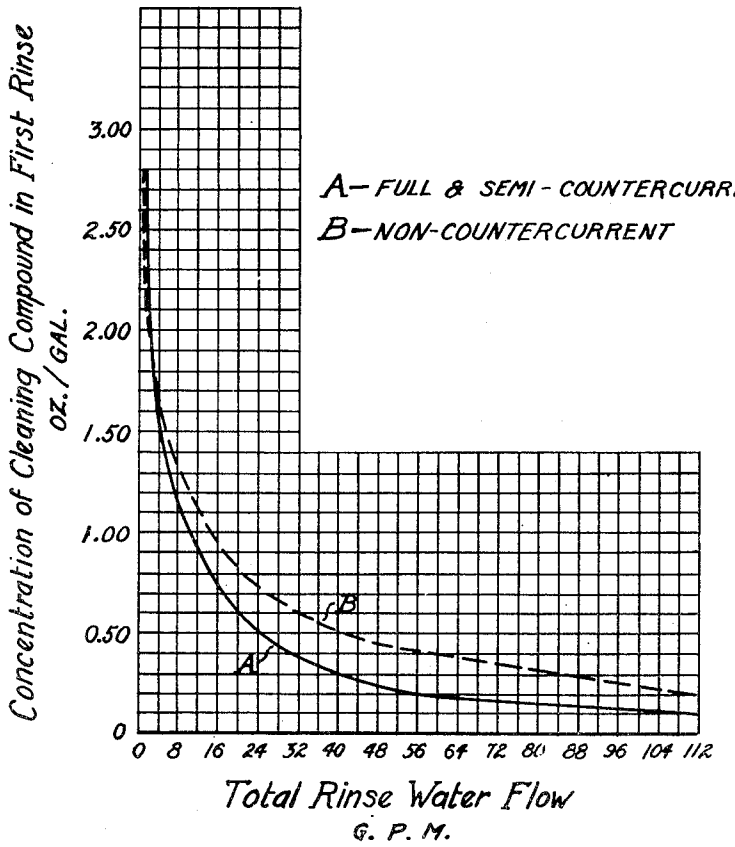


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Fig. 4.

Make-up Solution Strength VS. Rinse Water Counterflow



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Patented Nov. 14, 1950 2,529,762

UNITED STATES PATENT OFFICE

2,529,762

METHOD AND APPARATUS FOR CONTINUOUS CLEANING OF METAL STRIP

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Application April 11, 1946, Serial No. 661,251

7 Claims. (Cl. 134—10)

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This invention relates to a method and apparatus for continuously cleaning metallic strip.

Present day cleaners of the type herein disclosed are usually operated in such a manner that the dirt and oil removed from the object being cleaned is allowed to accumulate in the cleaning medium until a degree of contamination is reached which requires dumping of the solution, cleaning of the tanks and complete renewal of the bath. This procedure is costly and time consuming and the effectiveness of the cleaning operation ranges from good to bad through the cleaning cycle, thus resulting in erratic performance.

It is an object of this invention to provide a method of continuous cleaning wherein the performance is kept substantially constant and efficient.

Another object is to provide apparatus suitable for carrying out the method of my invention.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a schematic view of a horizontal type of cleaning unit;

Figure 2 is a schematic view of a vertical type of cleaning unit;

Figure 3 is a graph showing the contamination of the final rinse water under various conditions; and

Figure 4 is a graph showing the concentration of cleaning compound in the first rinse water under various conditions.

Referring more particularly to the drawings, the reference numeral 2 indicates a conventional uncoiler from which the strip is unwound as it passes through the strip cleaning line. From the uncoiler 2 the strip passes through pinch rolls 4 and then between the blades of a shear 6 which trims the ends of the coils before they are welded together with a conventional welder 8. The strip then passes through cleaning tanks 10 and 12 and rinsing tanks 14, 16 and 18. The clean strip passes from the tank 18 through pinch rolls 20, steam drier 22, and a low pressure air drier 24. From here it passes through a set of pulling rolls 26 into an accumulator pit 28. As the strip leaves the pit 28 it passes through side guides 30, pinch rolls 32, shear 34, tension rolls 36 and is finally wound upon a coiler 38. Tanks 10 and 12 are provided with steam heating coils 40 for maintaining the liquid therein at the desired temperature. In starting up, live steam is injected into the liquid in tanks 14, 16

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and 18 through conduits 41 to obtain the desired temperature. Thereafter, steam is injected into tank 18 only, this being sufficient to maintain the desired temperature in all the rinse tanks. The hot condensate from the heating coils is taken to the last rinse tank 18 to provide make-up water. This provides pure make-up water having considerable heat therein. If desired, the condensate and other water used as make-up water may be brought in through a heat exchanger 42. Solution overflowing from the first rinse tank 14 is passed through the heat exchanger 42 before being discharged into a sewer. Cleaning solution from the tank 10 is sprayed onto both sides of the strip S as it passes through the relatively high pressure (60 to 80 lbs. per square inch) jets 44. In some cases, especially when lower pressures are used, a combination of jets and scouring brushes may be used in place of the jets. The solution in the unit 10 passes downwardly into the tanks 46 where the sludge settles out and is removed through an opening 48 to the sewer. The tank is provided with steam heating coils 50 which maintain the desired temperature, the condensate therefrom being discharged into the last rinse tank. A pump 52 recirculates the solution back to the jets 44. Since the strip is dirtiest as it enters tank 10, the solution naturally becomes badly contaminated with grit, dirt, and oil, and it is necessary to continuously pump out a fraction of the recirculated solution by means of a pump 54 into a clarifying unit 56. The clarified solution passes into the tank 12 at its exit end and flows toward and into the tank 10. Thus the rate of circulation set by pump 54 determines the clarity of the cleaning solution throughout the unit.

After removal of the heaviest and largest part of the surface dirt by treatment in tank 10, the strip passes through wringer rolls 58 into tank 12 where it is acted upon by the cleaning solution which increases in cleanliness from the entry end of the tank since the clean solution is added at the exit end as pointed out above. Thus, as the strip increases in cleanliness, it is washed by increasingly clean solution which assures positive cleaning action during the entire period of strip travel in the cleaning unit. At the cleanest part of the cleaning tank, the strip passes between a set of electrolytic grids 60 where any foreign matter not previously removed by the action of the solution is blasted off. If desired the strip may be passed through an additional cleaning tank after passing between the grids 60.

The strip is then deflected out of the cleaning tank through a set of wringer rolls 62 into the first rinse tank 14 which should be maintained at a temperature of at least 90° F. The solution dragged out by the strip into the rinsing system contains a minimum amount of foreign material and will contaminate the rinse water only with relatively pure cleaning solution.

In the rinse system the water is brought in through the heat exchanger 42 where it is heated by the contaminated rinse water being discharged into the sewer. This water can be made to counterflow through all rinsing tanks or may be split up as shown between tanks 16 and 18 in order to effect some economy in steam. For best operation the water in tank 18 should be kept above 200° F. Thus, as the strip passes through tanks 14, 16 and 18, it encounters increasingly cleaner and hotter rinse water so that the final rinse under proper counterflow conditions contains a negligible amount of cleaning solution contamination. Excess liquid is wiped off the strip S as it leaves tanks 14 and 16 by means of wringer rolls 63. The cleaned strip is dried as it passes through the steam drier 22 and air drier 24. The weld between the coils of strip is cut out by means of the shear 34. In order to effect some reduction in cleaning solution consumption, a controlled part of the rinse water having cleaning solution therein is returned from tank 14 to the cleaning system through conduit 64, the flow being determined by a conventional float control 65 located in tank 46.

Figure 2 discloses a vertical type cleaner which is quite similar to the cleaner shown in Figure 1 except that the cleaning and rinsing tanks are arranged in a vertical position. Instead of two cleaning tanks, three are used, and the electrolytic grids 60 are located in this third tank 66 instead of in the second tank 12. The clarified solution from the clarifying unit 56 is also dumped into tank 66. Otherwise, the two units are the same and the same reference numerals are used to indicate the corresponding parts. This vertical unit permits a higher speed operation.

The graphs shown in Figures 3 and 4 represent concentration of cleaning compounds to be expected in the first and final rinses when a steel strip 30 inches wide is processed at 1200 feet per minute in both two and three stage rinse systems and a cleaning solution strength of 3 ounces per gallon is maintained in the cleaner. The line indicating straight counterflow shows conditions when all of the rinse water is inserted in the last rinse tank, whereas "50% counterflow" shows conditions when one-half of the water is inserted in the last rinse tank and one-half in the next to the last rinse tank. For example, in the units illustrated in Figures 1 and 2, when using 50% counterflow, there will be .01 ounce per gallon cleaning powder contamination in the last rinse water when there is a flow of 32 gallons per minute of water through the rinse system. This same flow results in a cleaning compound build-up of .38 ounce per gallon in the first rinse water. By using part of this as make-up water in the cleaning tank, a saving of 12.8% of cleaning powder is obtained.

In cases where relatively large amounts of soluble materials and oils are introduced into this system, the desirability of sewer discard of cleaning solution must be considered, but for cleaning cold reduced strip, the discard is unnecessary since some benefit results from some saponifiable oil contamination in the cleaning solution.

It is apparent that this system of cleaning can be carried out on single objects fastened to a conveyor system. In such cases, it would be necessary to replace the wringer rolls by other wringing devices such as air blasts or drainage areas.

While two embodiments of my invention have been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A continuous metal strip cleaning line comprising means for moving the strip through the line, a first tank at the entry end of the line, said tank containing cleaning liquid, pressure jets adjacent the first tank for spraying hot cleaning liquid on said strip, a second tank containing cleaning liquid, means for recirculating cleaning liquid from said first tank back to said jets, means for clarifying a portion of the dirty solution from said first tank and returning it to the exit end of the second tank, a plurality of rinse tanks through which the strip passes after leaving the second cleaning tank, means for introducing clean water into the last rinse tank, the water in said rinse tanks flowing from the last to the first rinse tank, and means for taking solution from the first rinse tank and introducing it into the recirculating means of the first cleaning tank.

2. A continuous method of cleaning metal strip or the like comprising spraying hot cleaning liquid on the strip, then passing the strip through a tank of cleaning liquid, clarifying the dirty liquid sprayed on the strip, returning the clean liquid to the exit end of the tank, then passing the strip through a plurality of rinse tanks with the water from the last rinse tank flowing through the tanks toward the first rinse tank, and taking some of the solution from the first rinse tank and introducing it into the cleaning liquid being clarified for make-up at a controlled rate.

3. A cleaning line for removing dirt and oil from metal strip comprising means for moving the strip through the line, a first tank at the entry end of the line, said tank containing cleaning liquid, pressure jets adjacent the first tank for spraying hot cleaning liquid on said strip, a second tank containing cleaning liquid through which the strip passes after passing through the first tank, means for recirculating cleaning liquid from said first tank to said jets, means for clarifying the dirty solution from said first tank and returning it to the exit end of the second tank, a plurality of rinse tanks through which the strip passes after leaving the second cleaning tank, means for introducing clean water into the last rinse tank, the water in said rinse tanks flowing from the last to the first rinse tank, means for taking controlled amounts of the solution from the first rinse tank and introducing it into the recirculating system of the first cleaning tank, steam coils in at least some of the tanks for heating the solutions therein, means for discharging the condensate from the steam coils into the last rinse tank, and means for removing excess liquid from the strip as it leaves each tank.

4. A cleaning line for removing dirt and oil from metal strip comprising means for moving the strip through the line, a first tank at the entry end of the line, said tank containing cleaning liquid, pressure jets adjacent the first tank

for spraying hot cleaning liquid on said strip, a second tank containing cleaning liquid through which the strip passes after passing through the first tank, a settling tank, a conduit leading from the lower portion of the first tank to the settling tank, a clarifying unit, means for delivering a controlled portion of the liquid in the settling tank to the clarifying unit, a conduit leading from the clarifying unit to the exit end of the second tank, means for delivering a controlled portion of the liquid in the settling tank to the pressure jets, a plurality of rinse tanks through which the strip passes after leaving the second cleaning tank, means for introducing clean water into the last rinse tank, the water in said rinse tanks flowing from the last to the first rinse tank, means for taking controlled amounts of the solution from the first rinse tank and introducing it into the cleaning liquid circulating system, and means for controlling the flow of solution from the first rinse tank to the circulating system.

5. A continuous method of removing dirt from metal strip or the like comprising spraying hot cleaning liquid on the strip, then passing the strip through a tank of cleaning liquid, clarifying the dirty liquid sprayed on the strip, delivering a portion of said clarified liquid to the exit end of the cleaning tank, delivering another portion of said clarified liquid to the cleaning liquid being sprayed, then passing the strip through a plurality of rinse tanks with the hot water from the last rinse tank flowing through the tanks toward the first tank, and taking solution from the first rinse tank and introducing it at a controlled rate into the cleaning liquid being clarified.

6. A continuous method of removing dirt from metal strip according to claim 5 in which the hot water of the initial rinse is maintained at a temperature of at least approximately 70° F. and the hot water of the final rinse is maintained at a temperature of at least approximately 200° F.

7. A continuous method of removing dirt from metal strip according to claim 5 in which at least part of the solutions are heated by steam coils and the steam condensate is discharged into the last rinse tank.

ANDRE H. BRISSE.

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