July 11, 1933. C. M. MacCHESNEY ET AL 1,917,657

GALVANIZING PROCESS AND APPARATUS

Filed Jan. 4, 1929 3 Sheets-Sheet 1

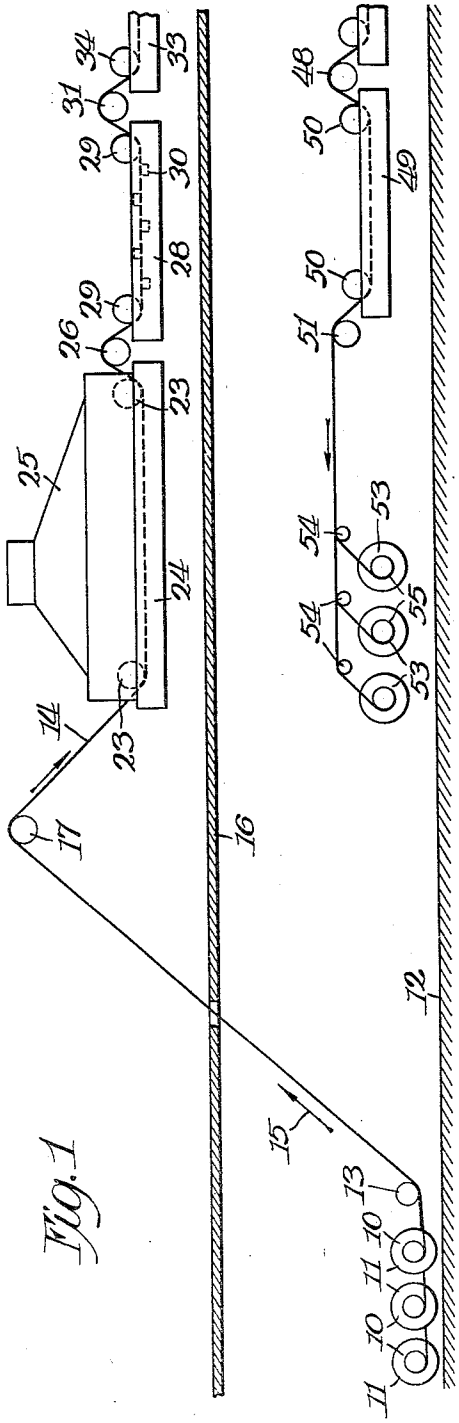

Fig. 1

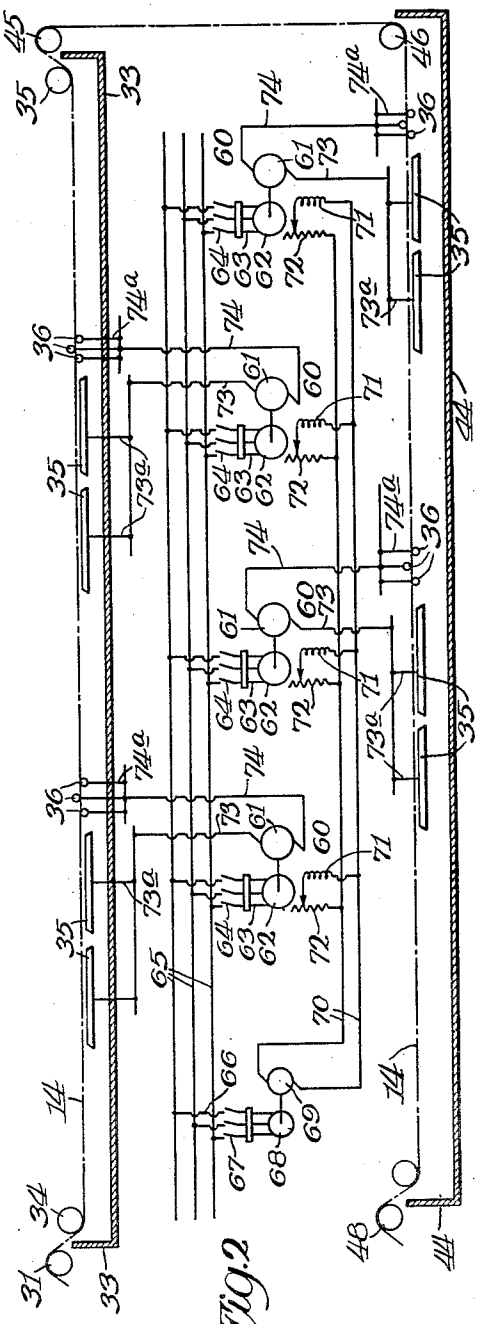

Fig. 2

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GALVANIZING PROCESS AND APPARATUS

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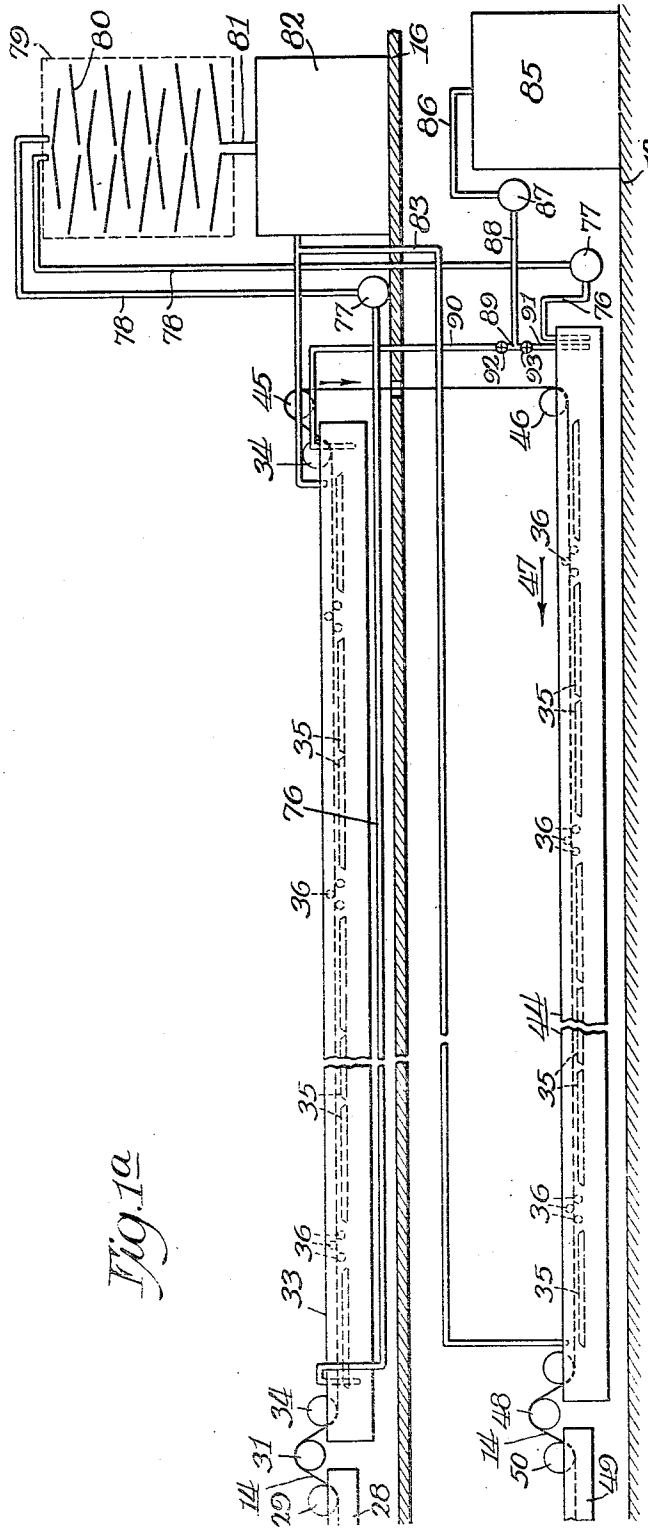

Fig. 1a

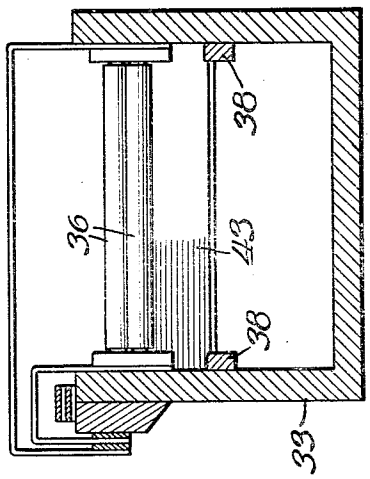

Fig. 3

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GALVANIZING PROCESS AND APPARATUS

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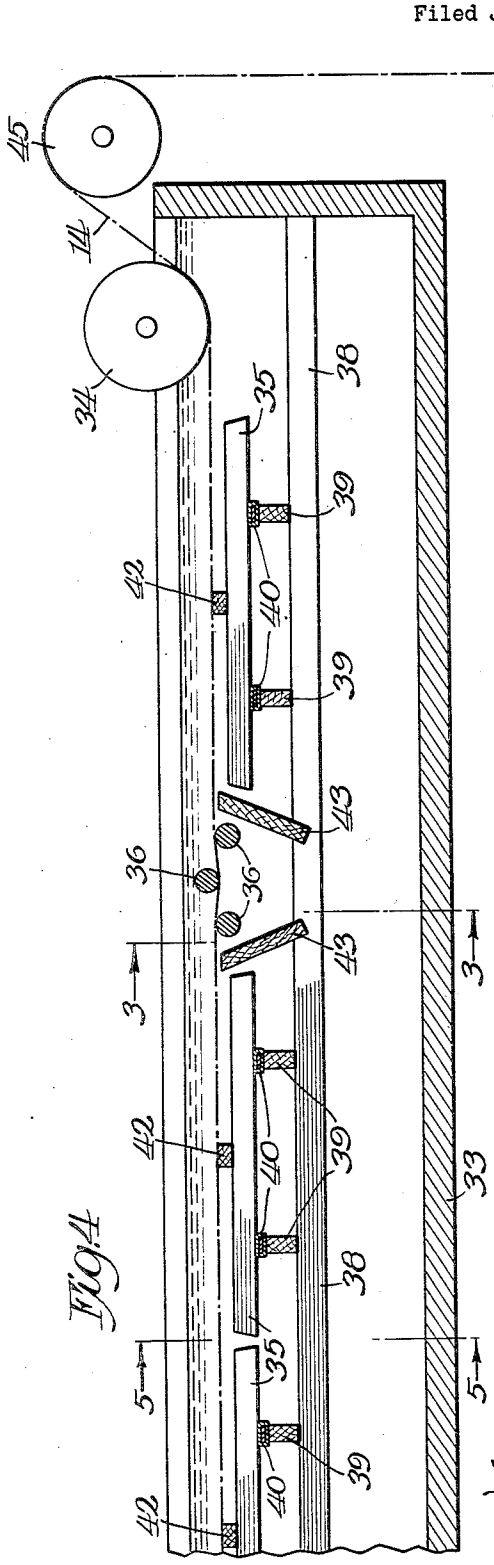

Fig. 4

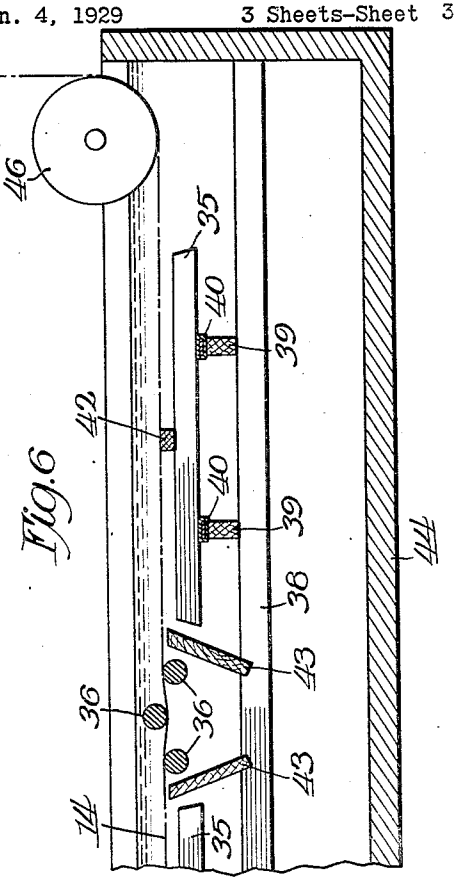

Fig. 6

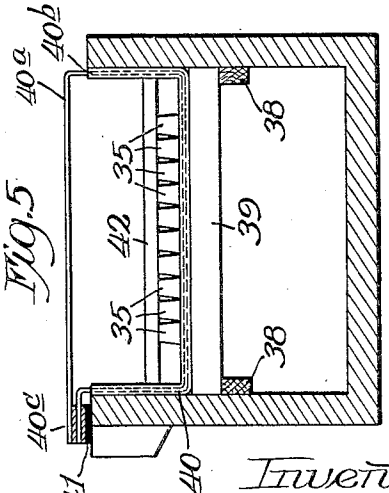

Fig. 5

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UNITED STATES PATENT OFFICE

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GALVANIZING PROCESS AND APPARATUS

Application filed January 4, 1929. Serial No. 330,393.

This invention relates to improvements in a process of galvanizing metal strips and sheets and its purpose is to provide an improved method and improved apparatus for providing strips of iron and steel and the like with a zinc coating. The principal object of the invention is to provide an improved method by which both sides of a metal sheet or strip may be thoroughly covered with the protective coating. A further object is to provide a method of galvanizing in which an elongated metal strip is moved through successive stages of the process and reversed in position between successive galvanizing stages in order that both sides of the sheet may be presented downwardly in succession to the action of the galvanizing fluid. Still another object is to provide a galvanizing process and apparatus including improved means for causing electric current to pass through the electrolyte. Other objects relate to various details of the improved method and to various features of construction and arrangement of the apparatus as will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings, wherein the invention is shown and described in connection with a particular form of apparatus. In the drawings,

Fig. 1 shows a partial longitudinal section through a building, illustrating diagrammatically in side elevation a portion of one form of apparatus adapted for use in carrying out the improved process;

Fig. 1ª is a sectional view and side elevation similar to that of Fig. 1 and showing the remainder of the apparatus used in carrying on the process;

Fig. 2 is a diagrammatic view showing the electrical connections and apparatus employed in the galvanizing process;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 4;

Fig. 4 shows an enlarged longitudinal section through a portion of one of the galvanizing tanks;

Fig. 5 shows a transverse section taken on the line 5—5 of Fig. 4, and

Fig. 6 is a partial longitudinal section through another galvanizing tank through which the metal strip is caused to travel in inverted position after passing through the galvanizing tank illustrated in Fig. 4.

The improved process herein described is preferably carried on in the treatment of very long strips of thin metal the parts of which are fed successively through the different stages of the process so that the galvanizing operation may be carried on continuously for long periods of time. These elongated metal strips are preferably relatively thin and may vary greatly in width, for example, from one-half to twelve inches. The untreated elongated metal strips are supplied to the galvanizing apparatus in the form of coils 10 wound on reels 11 which are located in suitable supports on a lower floor 12 of a building so that the strips may be unwound from the reels and gradually drawn through the various stages of the process. A horizontal roller 13 is mounted adjacent to the reels 11 and the strips 14 of the metal to be coated are drawn from the coils 10 and thence directed upwardly about the roller 13 in the direction indicated by the arrow 15. One or more strips 14 may be arranged side by side and treated simultaneously throughout the various stages of the process, the number of such strips depending upon their individual widths. Suitable means, not illustrated, are preferably employed for maintaining a separation of the adjacent strips during their travel. For convenience, the succeeding steps of the process will be described with reference to a single metal strip 14. After passing beneath the roller 13 the strip 14 is carried upwardly through an aperture in an upper floor 16 of the building, since the process is preferably carried out on two superimposed floors, although the upper floor 16 may be an overhead platform in the room of which the support 12 constitutes the floor. After passing through the opening in the floor 16, the metal strip 14 passes upwardly over a roller 17, being propelled in its travel by the action of the winding mechanism, hereinafter described, by which the finished galvanized strips are wound on suitable reels.

After passing the roll 17 the metal strip 14 is directed downwardly again to pass beneath two rollers 23 which are located in a pickling tank 24 containing a dilute solution of sulphuric acid, or the like, which serves to clean thoroughly the surfaces of the metal strip and to loosen up any scale which may be carried thereon. The pickling tank 24 has a hood 25 mounted thereover from which the fumes or the like are drawn off and at the discharge end of this tank the metal strip 14 is carried upwardly over a roller 26 which elevates the strap over the end of the pickling tank 24 and also over the end of the succeeding washing tank 28. The metal strip 14 passes downwardly into the tank 28 and beneath two rollers 29. In this tank there are located brushes 30 or other cleaning members formed of suitable fibrous material for exerting a wiping and brushing action on the surfaces of the metal strip as it passes through this tank which is substantially filled with clean water continuously supplied thereto and permitted to flow continuously therefrom. The action of the washing tank serves to clean thoroughly the surfaces of the metal strip so that all scale and other objectionable particles and the acid are removed therefrom. The metal strip is then in readiness to receive the protective coating and it is carried upwardly over a roller 31 located between the washing tank 28 and the first galvanizing tank 33.

This tank is in the form of an elongated flat vessel having rollers 34 at the opposite ends thereof in which the metal strap 14 is caused to pass. This tank contains a suitable galvanizing solution such as is commonly employed for galvanizing purposes, which may be a solution of sal ammoniac and earthy matter, but which is preferably a well known galvanizing electrolyte known as "Meaker solution". As the metal strip 14 passes through the tank 33 it is carried over a plurality of anode bars 35 and is caused to pass between a number of transversely extending cathode bars or rolls 36 which are connected to the corresponding terminals of an electric circuit so that they constitute the terminal plates of the electrolyte contained in the tank 33 and, as the metal strip 14 passes along in proximity to the bars 35 and in contact with the bars 36, the galvanic action set up in the electrolyte by the passage of the current therethrough results in the deposit on the metal strip of a protective coating of zinc transferred thereto from the anode bars 35. The construction and arrangement of the parts within the galvanizing tank 33 is illustrated particularly in Figs. 4 and 5 where the vertical side walls of the tank are shown as being provided with a longitudinal supporting members 38 having mounted thereon a number of transverse supporting members 39 formed of wood. Each transverse member 39 carries a positive terminal bar 40 of the electric circuit which is bent into the form shown in Fig. 5 and which consists of a member 40^a of copper or the like provided along its vertical arms and across its lower part with a continuous protective coating 40^b of lead which prevents a deteriorating action upon the copper bar of the electrolytic solution within the tank. The terminals of the portion 40^a of the bar are extended over one side wall of the tank as shown at 40^c and are mounted on suitable insulating blocks 41. The anode bars 35 formed of pure zinc are arranged side by side on the terminal bars 40, two of these bars serving as supports for a series of closely arranged anode bars. Each series of these bars 35 has a wooden spacing member 42 resting thereon to engage the under side of the metal strip 14 so that this strip is spaced from the anode bars and prevented from coming in contact therewith. Between adjacent groups of the anode bars 35, the transversely extending cathode rolls 36 are located, preferably with three rolls in a group arranged so that the metal strip 14 passes over two of the rolls and beneath an intermediate third roll which deflects the strip slightly downwardly thus insuring a close contact of the metal strip with the surfaces of the cathode rolls which are slidably engaged thereby during its travel. In order to prevent the current from passing directly through the electrolyte between the anode bars and the cathode rolls, wooden deflecting plates 43 are mounted to extend transversely between the side walls of the tank to separate the ends of the bars 35 of one group from the nearest cathode roll 36, the upper edges of the wooden deflecting plates 43 being spaced downwardly below the metal strip 14. The galvanic action carried on in the tank 33 results in a deposit of zinc on the metal strip 14 but this coating is largely confined to the lower surface thereof and, in order to effect a complete and thorough coating of both sides of the metal strip, it is necessary that both sides be presented downwardly to the action of the galvanic solution through which the current passes. This is accomplished in the present invention by reversing the metal strip and causing it to travel in the opposite direction through another galvanizing tank 44 in which the side of the metal strip which was previously directed upwardly is directed downwardly to receive the protective coating. For this purpose the metal strip 14, after passing beneath the roll 34 at the rear end of the tank 33, is carried upwardly and around a roll 45 and thence downwardly and under one of the rolls 46 which are located at opposite ends of the galvanizing tank 44. The tank 44 is located on the lower floor 12 of the building and the metal strip in passing downwardly to this tank is led through a hole in the floor 16. The tank 44 is similar

to the tank 33, being provided with similar anode bars 35, cathode bars 36, terminal bars 40, supporting members 38 and 39 and deflecting plates 43. As the metal strip travels through the tank 44 in the direction indicated by the arrow 47 in Fig. 1ª, the lower side of the metal strip receives its protective coating of zinc so that when the metal strip emerges from the other end of the tank, both sides thereof are coated.

The metal strip 14 carrying its galvanizing coating is caused to pass upwardly over a roller 48 and is thence directed downwardly into a washing tank 49 where the metal strip is retained by rollers 50 beneath the surface of the clean washing fluid contained therein so that all traces of the galvanizing solution and the like are removed from the strip. From the washing tank 49 each strip passes upwardly over a roller 51 and the several strips are thence carried over individual rollers 54 in passing to the power driven winding reels 53 by which the strips are drawn through the apparatus from the supply coils 10. Assuming that a plurality of strips 14 have been treated, all of these strips are wound simultaneously, each strip being wound on an individual reel 53 after passing over a roll 54, thus forming a coil 55 of sheet metal having a galvanizing coating thereon. It will be observed that the movement of the strap in the second stage of the galvanizing process and in the final washing and winding operations is toward the point on the floor 12 at which the uncoated strip was first started in its movement through the various stages of the process. The operation may be carried on continuously for long periods of time, the end of the uncoated strip 14 drawn from a reel 11 being connected to the outer end of the strip on a new reel so that the supply of material may be kept up without any breakage in the line of the continuous strip of metal being treated.

The electrical connections of the apparatus employed in the galvanizing process are illustrated diagrammatically in Fig. 2 which illustrates the upper and lower galvanizing tanks 33 and 44, respectively, having mounted therein the anode bars 35 and the cathode rolls 36. The current is supplied by a number of motor generator sets 60 each comprising a direction current generator 61 and an alternating current synchronous motor 62 having their rotors mounted on the same shaft. The synchronous motors 62 are connected through conductors 63 and switches 64 with the alternating current three-phase supply line 65 and this supply line is also connected through conductors 66 and a switch 67 with a small induction motor 68 which drives a direct current exciter generator 69, the brushes of which are connected through supply conductors 70 with the field windings 71 of the motor generator sets 60, the circuits of which have rheostats 72 connected therein. Each direct current generator 61 of a motor generator set has its positive terminal connected by a conductor 73 and branch conductors 73ª with the terminal bars of one or more groups of anode bars 35 and the negative terminals of the same generator 61 are connected through a conductor 74 and branch conductors 74ª with the terminals of an adjacent group of cathode rolls 36, these terminals being located on one of the walls of the tanks 33 or 44. In the embodiment illustrated in the drawings, two motor generator sets are employed for supplying current to the anode and cathode bars of each of the galvanizing tanks 33 and 44.

To facilitate the continuous use of the galvanizing solutions in the tanks 33 and 44, means are provided for effecting a continuous circulation and cooling of these solutions and means are also provided for supplying fresh galvanizing solution to either of these tanks when desired. Each tank 33 and 44 has a pipe 76 leading from the inlet end thereof to a centrifugal pump 77 which is adapted to withdraw the galvanizing fluid from the connected tank and force it upwardly through one of the pipes 78 from which it is discharged into the upper part of a cooling tower 79 having located therein a plurality of inclined offset cooling plates or vanes 80 which cause the fluid to pass downwardly by gravity through irregular pathways in contact with the relatively large cooling surfaces with the result that a relatively cool galvanizing fluid is discharged from the bottom of the tower 79 through the conduit 81 into the storage tank 82 from which the fluid flows back by gravity through the pipes 83 to the outlet ends of the tanks 33 and 44. The tank 82 and the cooling tower 79 are preferably located on the upper floor 16. On the lower floor 12 there is located a supply tank 85 connected through a pipe 86 with a centrifugal pump 87 having its discharge pipe 88 connected to a coupling 89 from which the flow to the tanks 33 and 44 through the pipes 90 and 91, respectively, is controlled by the respective valves 92 and 93. Upon opening these valves, the supply of galvanizing fluid in the tanks may be replenished by operating the pump 87.

The improved method herein described is of particular advantage in that it permits the carrying on of the galvanizing process in a continuous operation without interruption and without the necessity of twisting the metal strips in order to cause them to acquire a uniform protective coating on both sides. Since no twisting operations are performed upon the metal strips, the process of the present invention is capable of operation upon

metal strips or sheets of relatively great width, thus permitting galvanizing of strips of this size much more rapidly than was heretofore possible.

Although one form of galvanizing apparatus and one example of the improved method have been set forth herein by way of illustration, it will be understood that both the method and the apparatus may be modified within the scope of the appended claims.

We claim:

1. The combination in galvanizing apparatus of a tank adapted to contain an electrolytic coating solution, a plurality of conducting bars connected in an electric circuit and located in said tank, protective coverings for said bars, a plurality of anode bars resting on said protective coverings in said solution, a cathode bar connected in said circuit and located in said solution in said tank, and means for drawing a metal strip over said anode bars and in contact with said cathode bar.

2. The combination in galvanizing apparatus of a tank adapted to contain an electrolytic coating solution, a plurality of conducting bars mounted in said tank and connected in an electric circuit, conducting protective coverings for said bars, anode bars mounted on said coverings, a non-conducting member mounted over said anode bars, a plurality of cathode bars connected in said circuit and located in said solution in said tank, and means for drawing a metal strip over said non-conducting member and between and in contact with said cathode bars.

3. The method of galvanizing metal which consists in moving an elongated strip of metal endwise through a bath in contact with a cathode bar and having an anode bar located on one side only thereof, and then reversing the direction of movement thereof and moving it in said inverted position and in said reversed direction through another bath of said coating solution in contact with a cathode bar having an anode bar located in the same position with respect thereto as in said first named bath.

4. The method of galvanizing a flat metal strip which consists in passing said strip endwise between stationary anode and cathode bars submerged and superimposed in the same relationship in each of a plurality of successive baths of coating solution, and inverting said strip between said baths whereby both sides of said strip are coated.

5. The method of galvanizing a flat metal strip which consists in pulling said strip endwise between stationary anode and cathode bars submerged and similarly superimposed in each of a plurality of successive baths of coating solution, and inverting said strip between adjacent baths whereby both sides of said strip are coated.

6. The combination in galvanizing apparatus, of a pair of tanks each adapted to contain an electrolytic coating solution, a plurality of anode and cathode bars submerged in said solution in each of said tanks, said anode and cathode bars being superimposed in the same relationship in each of said tanks, an electric circuit in which said bars are connected, means adapted to engage the flat metal strip beyond said tanks for pulling said strip endwise between the anode and cathode bars in each of said tanks, and means for inverting said flat metal strip between said tanks whereby the opposite sides of said flat metal strip are coated.

7. The method of galvanizing a flat metal strip which consists in passing said strip endwise through successive baths of coating solution, each having submerged therein anode and cathode bars disposed on opposite sides of said strip, disposing one side of said flat metal strip toward said anode bars in one of said baths, and disposing the other side of said strip toward said anode bars in the other of said baths, whereby both sides of said strip are coated.

8. The method of coating a non-endless elongated metal strip which consists in passing said strip endwise through two successive electrolytic coating baths having anode bars located only below the strip, inverting said strip between said baths, and moving it in the second bath in a direction opposite to its movement in the first bath, whereby said strip is coated only on the under side thereof in each bath.

In witness whereof, we have subscribed our names.

CHESTER M. MacCHESNEY.
RALPH H. NORTON.