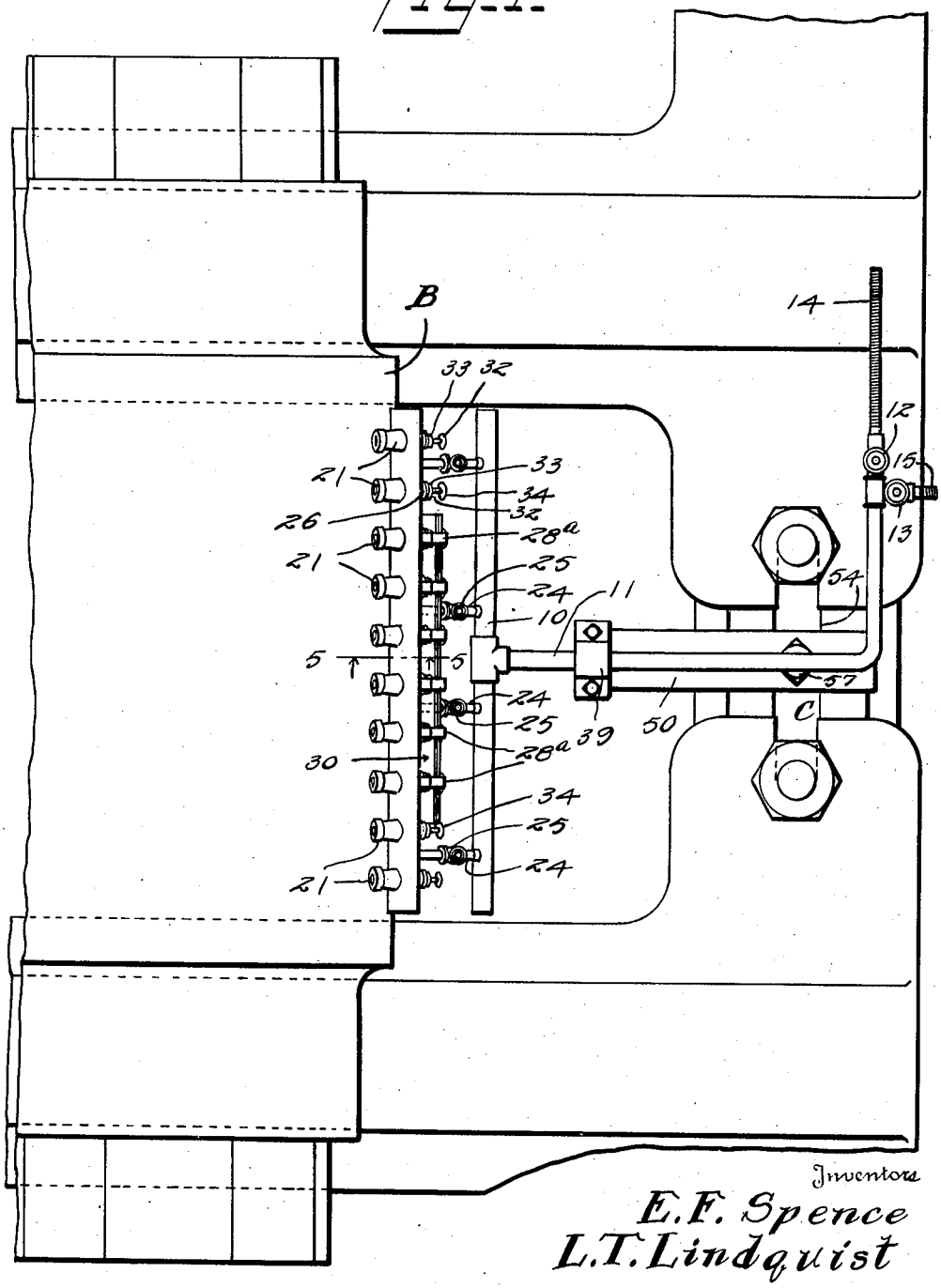
Dec. 15, 1936. E. F. SPENCE ET AL 2,064,182

ROLL TEMPERATURE REGULATOR FOR SHEET MILLS

Filed June 4, 1935 3 Sheets-Sheet 1

Fig. 1.



Inventors
E. F. Spence
L. T. Lindquist
By Watson E. Coleman
Attorney

Dec. 15, 1936. E. F. SPENCE ET AL 2,064,182

ROLL TEMPERATURE REGULATOR FOR SHEET MILLS

Filed June 4, 1935 3 Sheets-Sheet 2

Fig. 2.

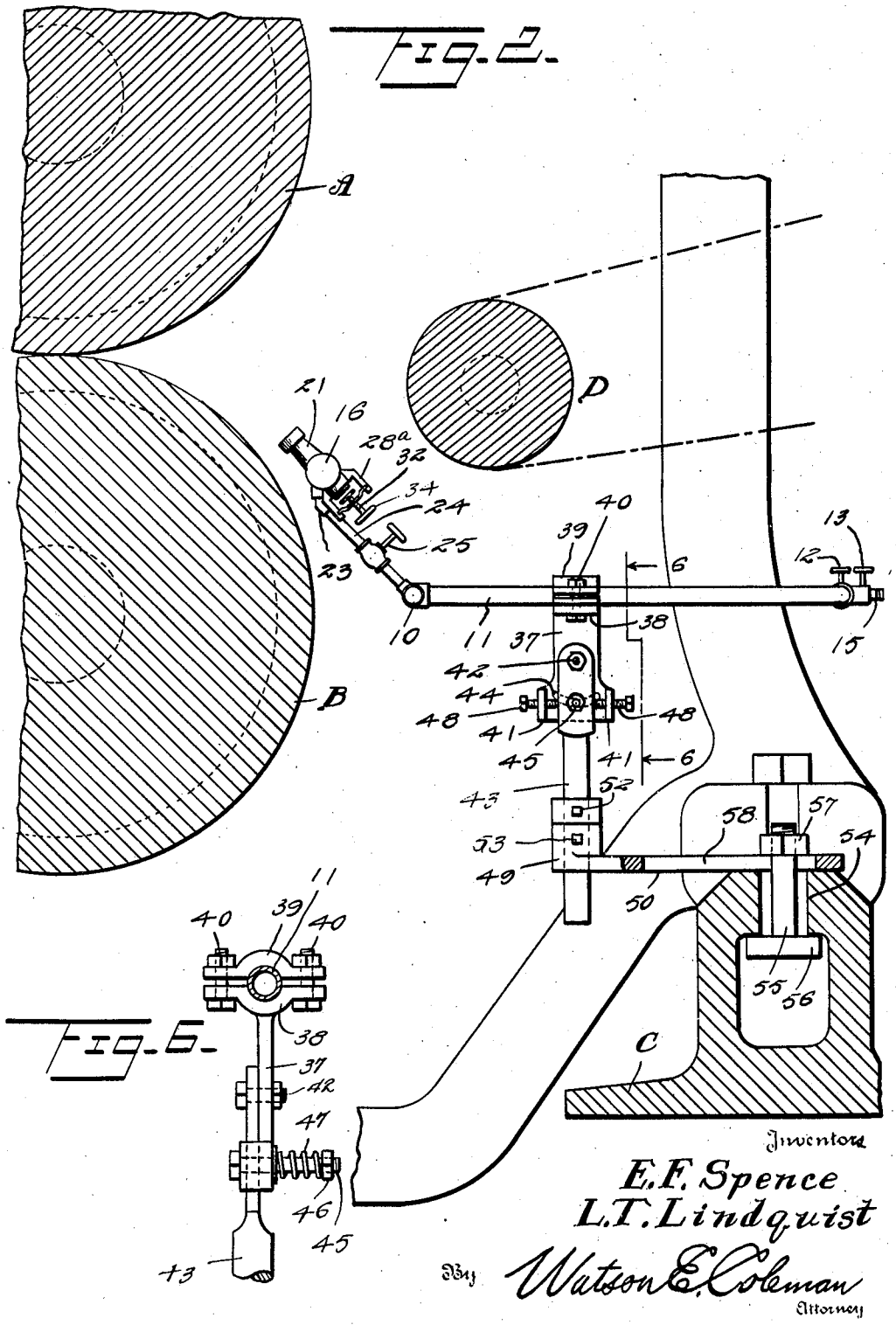


Fig. 6.

Inventors
E. F. Spence
L. T. Lindquist
By Watson E. Coleman
Attorney

Dec. 15, 1936. E. F. SPENCE ET AL 2,064,182

ROLL TEMPERATURE REGULATOR FOR SHEET MILLS

Filed June 4, 1935 3 Sheets-Sheet 3

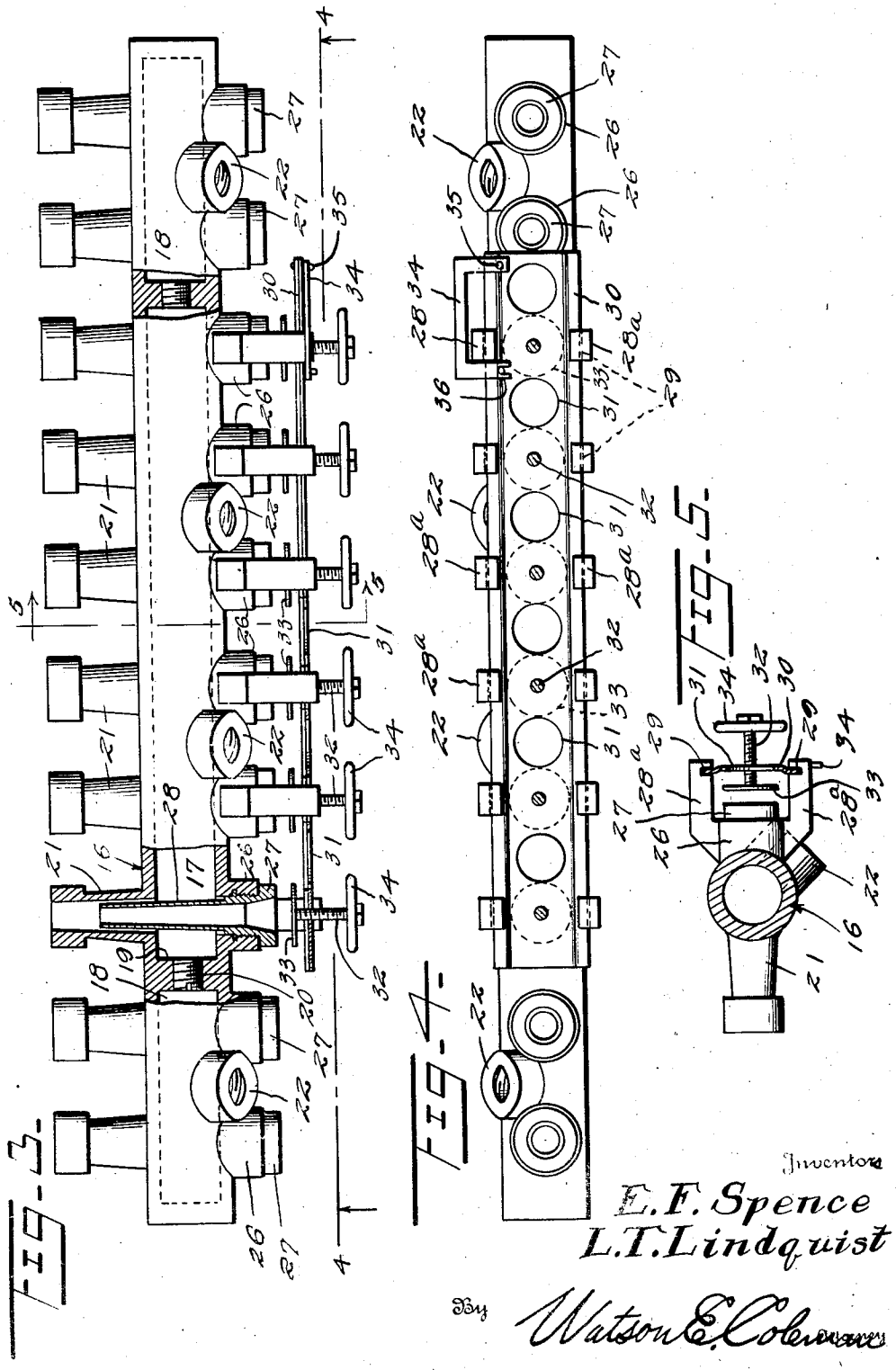


FIG. 3.

FIG. 4.

FIG. 5.

Inventors
E. F. Spence
L. T. Lindquist
By Watson E. Coleman

Patented Dec. 15, 1936 2,064,182

UNITED STATES PATENT OFFICE

2,064,182

ROLL TEMPERATURE REGULATOR FOR SHEET MILLS

Earl F. Spence and Louis T. Lindquist, Fairfield, Ala.

Application June 4, 1935, Serial No. 24,968

12 Claims. (Cl. 80—41)

This invention relates to devices for warming up a pair of rolls in sheet mills, and the general object of the invention is to provide means whereby after a pair of rolls start turning, the rolls may be warmed up.

In sheet rolling mills, the upper roll is originally made so that it is concave from end to end whereby as the rolls become heated and the middle portion of the upper roll expands, the upper roll will fit straight against the lower roll. If the rolls become too hot, the rolls will puff, as the term is, so that the rolls will become convex from end to end.

The broad object of this invention, therefore, is to provide means for initially heating the rolls and particularly the upper rolls so as to expand the middle portion of the roll and then to retain the shapes of the upper and lower rolls either by the application of heat from time to time or by cooling the upper or lower roll or both so as to bring the rolls into proper shape and retain them in this shape, which means is particularly adapted to be used with any two or three high sheet tin or high finish mill, and particularly adapted to rolling mills having automatic tilting finishing tables.

A further object is to provide a temperature regulator by which both rolls can be brought to a uniform temperature and shape and which may be used when there are delays in operation.

A further object is to provide a temperature regulator which may be used not only for warming up rolls but for cooling them to thus secure a uniform degree of temperature in the rolls.

A still further object is to provide means whereby the temperature regulating mechanism may be controlled so as to provide improved rolling conditions for relatively narrow material being rolled.

Still another object is to provide a regulator which is so constructed as to be capable of directing jets of gas and air or jets of steam and air against either the bite of the rolls or against either the upper or lower roll.

Other objects will appear in the course of the following description.

Our invention is illustrated in the accompanying drawings wherein:

Figure 1 is a top plan view of our improved temperature regulating means for sheet metal rolls, the upper roll being removed;

Figure 2 is a side elevation of a portion of the housing for the rolls and a side elevation of our temperature regulating mechanism, the base being in section;

Figure 3 is an underside elevation of the manifold partly broken away;

Figure 4 is a section on the line 4—4 of Figure 3;

Figure 5 is a section on the line 5—5 of Figure 3;

Figure 6 is a section on the line 6—6 of Figure 2, but with the manifold, header, etc., omitted.

Referring to these drawings, A and B designate, respectively, the top and bottom rolls of a sheet rolling machine in which a tilting feed table is used, this machine having a bed plate C, the tilting table being designated D. These parts are diagrammatically shown as they form no specific feature of our invention.

Our invention relates to means, as before stated, for initially warming up the rolls A and B while the rolls are rotating and for controlling or regulating the temperature of these rolls during their period of operation. To this end, we provide in conjunction with each pair of rolls A and B a header 10. This header is connected by a pipe 11 to a source of gas or steam. To this end, this pipe 11 is connected through the valves 12 and 13 to a gas inlet pipe 14 and a steam inlet pipe 15. Any suitable connection may be made to permit either the steam to pass into the pipe 11 or gas to pass into this pipe. The pipe 11 is supported in a manner which will be later described upon the bed plate C, and is adjustably supported upon this bed plate so that the jets of gas or steam may be directed either toward the upper roll A or the lower roll B, or preferably to the bite of the rolls.

Spaced from the header 10 but extending parallel thereto is a manifold 16. This manifold is divided into three chambers, namely, a relatively long medially disposed chamber 17 and two laterally disposed chambers 18. The chambers 18 are preferably separated from the chamber 17 by walls 19 having therein the plugs 20, but it will be understood that it is within the purview of our invention to form these lateral chambers 18 separate from the chamber 17.

The manifold is provided along its length at equi-distant points with outwardly projecting jet nozzles 21, there being two of these nozzles shown for each of the chambers 18 and six nozzles shown for the chamber 17. Obviously the number of these nozzles may be varied to suit the length of the rolls. The chambers 18 and the chamber 17 are provided with inlet ports 22 defined by outwardly extending hubs or interiorly screw thread-

ed collars and each of these collars is connected to an L 23, which in turn is connected to a pipe 24 in the length of which is disposed a valve 25, the pipe 24 being in turn connected to the header 10, thus gas or steam entering the header 10 will be discharged through the pipes 24 into the chambers 17 and 18 and will be discharged out through the nozzles 21.

Opposite each nozzle 21, there is provided the interiorly screw threaded hub 26 and having screw threaded engagement in these hubs is the basal portion 27 of an air inlet nozzle 28, this nozzle 28 extending across the corresponding chambers 17 or 18 and extending into the nozzle 21 but being spaced from the wall thereof. Thus when gas or steam is ejected from a nozzle 21, it will act to draw air in through the nozzle 28 and discharge this air with the gas or steam. The purpose of discharging air into the central portion of the steam jet is to cool the steam without, however, condensing it, as will be later stated, and the purpose of discharging air into the center of a gas jet is to secure perfect combustion of the gas.

Each of the hubs 26 is formed with a pair of rearwardly extending lugs 28a, the inner faces of these lugs being grooved at 29. Disposed within these grooves is a longitudinally slidable plate 30, this plate being provided at spaced distances with openings 31 and through the imperforate portions of this plate between these openings passes the screw threaded stem 32 of a damper or valve 33. The stem 32 is provided with a handle 34 whereby the damper or valve 33 may be shifted toward or from the enlarged rear end of the nozzle 28. It will be understood that there is one of these valves or dampers 33 associated with each of the nozzles 28. When gas is being used, it is necessary to regulate the amount of air which passes through the nozzle 28 so as to secure proper combustion of the gas, and under these circumstances, the plate 30 is so shifted as to bring the disks or valves 33 directly opposite the rear ends of the several nozzles 28. Then the screws 32 may be turned to shift the disks or valves 33 nearer to or further from the rear ends of the nozzles 28 to secure a proper amount of air for the gas which is being discharged from the nozzles 21, but where steam is being used, there is no necessity of this controlling valve 33, but it is desirable to let all the air possible enter the rear ends of the nozzles 28, and to this end the plate 30 is adapted to be shifted in the grooves 29 so as to carry the ports or openings 31 into position immediately opposite the several nozzles 28. It will be seen that there is no damper plate shown associated with the nozzles extending from the chambers 18, though we do not wish to be limited to this as hereinafter stated. The gas pressure may be increased anywhere needed along the rolls by regulating the valve controlling passage of gas to the chamber 17 or the valves controlling the passage of gas to the chambers 18.

In Figure 3, we have provided means whereby the damper may be limited in its shifting movement so that the workman does not have to be particularly careful in shifting this plate 32 so as to bring the openings 31 immediately behind the rear ends of the nozzles 28 or to bring the disks 33 immediately behind these nozzles, and to this end we have provided a U-shaped yoke 34, this yoke being pivoted at 35 to the sliding plate 32 at one end and at the other end being notched at 36 for engagement with a pin projecting upward from the sliding plate 32. This yoke embraces one of the lugs 28 and this yoke has a length equal to the throw of the plate 32 in order to bring either the valve disks 33 or the openings 31 behind the respective nozzles.

The pipe 11 with the header 10 and the manifold carried thereby is mounted for oscillation so that the jets of steam or gas ejected from the manifold may be directed either to either roll or to the bite between the rolls. To this end the pipe 11 is supported upon a bracket 37, the upper end of which is provided with a head 38 formed to provide a seat for the pipe 11 and coacting with this head is a clamp 39 which is likewise formed to partially embrace the pipe 11 and which is bolted to the head 38 by means of the bolts 40. The lower end of this bracket 37 is extended laterally in opposite directions and is provided with the outwardly extending lugs 41. This bracket 37 is pivoted by a bolt 42 to the upper end of a standard or support 43. The lower end of the bracket is provided with an arcuate slot 44 and passing through the upper end of the support 43 and through the slot 44 is a bolt 45 carrying a nut 46 and disposed between this nut and the bracket 37 is a compression spring 47 which thus frictionally bears against the bracket and holds it in frictional engagement with the upper end of the support 43. Extending through the lugs 41 are the set screws 48 which bear against the opposite edges of the support 43. By turning off one of these set screws and turning in the opposite set screw, the bracket 37 may be shifted around its pivot 42 to thus incline the pipe 11 in a direction to cause the jets from the manifold to be discharged either against the top roll, the lower roll or the bite between the rolls. After the manifold has been partly adjusted, the set screws are turned home and thus hold the bracket 37 in its adjusted position. When both set screws 48 are turned outward, the bracket may be very precisely swung upon its pivot to secure the proper adjustment by reason of the frictional engagement between the bracket and the support 43 caused by the spring 47.

The support 43 extends down through the elongated tubular head 49 which is carried upon an arm 50. The supporting lug 43 is provided with a collar 51 which is held in any adjusted position upon the supporting rod 43 by means of the set screw 52 so that the support 43 may be vertically adjusted. A set screw 53 extends through the head 49 and engages the support 43 and locks it in its adjusted position. It will be seen that the support 43 may thus be shifted vertically or rotatably shifted within the head 49 and clamped by the set screw 53 in its adjusted position. The supporting arm 50 engages over the upper face of the bed plate C. This bed plate is provided with a T-slot 54 and extending down through the arm 50 is a bolt 55 having a head 56 at its lower end engaging in the widest part of the T-slot and having a nut 57 which bears upon the upper end of the arm. By loosening this nut, it will be seen that the slide constituted by the head 56 and the bolt shank 55 may be shifted along the bed plate to any desired position and then clamped. With this construction, by releasing the set screw 53, the supporting rod 43, the bracket 37, the pipe 11 and the header and manifold may be readily removed or readily replaced without removing arm 50 from its position upon bed plate C. An arm 50, as will be seen, is longitudinally slotted at 58 so that the arm may be shifted longitudinally upon bolt 55 or may be rotated. Thus, every

provision is made for the proper adjustment of this temperature regulator with reference to the rolls.

We do not wish to be limited to the use of a sliding plate **32** carrying the disk-like valves or dampers **33** as this structure might be varied to secure the same result without departing from the spirit of the invention as defined in the appended claims. Thus it is within the purview of our invention to extend the valve plate **30** for the entire length of the manifold **16** instead of, as illustrated, the valve plate only extending behind the middle section of the manifold.

In the operation of this mechanism, it is first used for the purpose of warming up the rolls. Commonly electric warmers, which are no part of our invention, are used before the rolls start turning. After the electric warmers are removed and the rolls start turning, our improved regulator is put in operation. This regulator will warm up a pair of rolls in five or six hours where electric warmers are not used, whereas it takes six to eight hours with the electric warmers and the rolls not turning. After the electric warmers are removed, our improved regulator is used, as before stated.

In warming up the rolls, the damper plate **30** is so shifted as to bring the disks **33** opposite the nozzles **28**, that is, the plate **30** is shifted to the right as far as it is permitted by the stop yoke **34**. This is the position for gas burning. Gas is then admitted to the header and the gas is ignited at the nozzles, the air for combustion being drawn in by the gas passing through the tapered nozzle **21** past the end of the air nozzle **28**. The gas flames are, of course, regulated by controlling the valves **25** and the regulator is kept in operation until the rolls are properly warmed up for the material being rolled. The gas pressure anywhere needed along the rolls may be controlled by regulating the center, left or right valves **25** of the regulator. After the rolls have been properly warmed up and the temperature reaches 720° F., the gas is turned off and the steam is allowed to flow to the header **10** to thereby control the shape of the rolls to meet the material being rolled and hold a normal degree of temperature. The material may have a tendency to expand a portion of the rolls either in the center or to the left or to the right side, and this regulator provides means to direct the steam to that particular part of the rolls and yet hold a normal degree of temperature. The steam passing out through the nozzles **21** will, of course, draw in air through the nozzles **28**. This air cools the steam but does not condense it. As the steam pressure is increased, more air is drawn in, and as the steam pressure is decreased, less air is drawn in through the nozzles **28**.

As the hours of operation increase, the width of material being rolled has to be decreased. Thus 32 inches is the maximum width of material for a 38 inch pair of rolls. After a certain number of hours of operation, the width of material is decreased to 32 inches and so on down to 24 inches. With this mechanism, the right and left sections of the regulator may be cut off and still have a thoroughly efficient regulator for the width of material being rolled. We have provided means whereby steam may be directed to the narrow portions of the rolls where narrow material is being rolled, thus securing improved rolling conditions for narrow material. It will be seen that this regulator is so constructed as to direct steam or gas to the top or bottom roll as occasion may require, or to the bite of the rolls. One particular feature of our invention, aside from the use of the manifold, nozzles and combined air or steam jet is separating the nozzles into sections, each section being controlled by a separate valve. This device will act either as a steam and air blower or a gas burner and when, of course, gas is used, there is no necessity of using steam. A further advantageous feature in this structure is that the manifold with its nozzles is adjustable so as to discharge the steam or gas in any direction desired and, furthermore, that the manifold with its nozzle is adjustable vertically upon the manifold stand, that is, upon the arm **50** or is rotatably adjustable around the axis of the supporting rod **43** or is rotatably adjustable around the axis of the bolt **55**, and further, this support **43** is vertically adjustable. Thus every essential adjustment is secured by the mounting which we have provided for this regulator.

Another feature of importance is that the regulator is supported on a bed plate or solid foundation C and in no way touches any moving part of the mill, and in this connection, it is pointed out that we have provided a supporting means which permits the regulator to be readily removed or readily replaced. This is necessary whenever the rolls have to be changed. The regulator is relatively light and can be easily installed by one man, the weight being only sixty-seven pounds.

Another feature is that there is nothing to wear out on this regulator except, of course, the normal wear due to the passage of steam or gas through the valves and the up and down movements of the stand. The maximum pressure of steam may be increased by decreasing the size of the air jets giving more steam clearance. Of course, it will be understood that this regulator will be made in different sizes for different sized rolls. The principle will remain the same only more nozzles will be used. Our regulator may also be used with air under pressure in the same manner as used for steam or gas.

As illustrated in the drawings, the manifold **16** has a damper, for use only with burning gas, this damper being applied on the middle section of the manifold only. The reason for this is that initially the top roll A is longitudinally concave at its middle portion and the mechanism which we have shown is designed to warm up the rolls or expand the concave roll at the middle of the roll. The damper is not absolutely necessary in order to permit the manifold to burn gas and warm up the rolls where the gas is at a normal pressure, but after a certain amount of pressure is used, the air clearance will be found to be too large and, therefore, we provide the damper for high pressure gas which is used only on the middle portion of the rolls. Therefore, it is reiterated that this regulator may be used with the damper extending all the way across and associated with the end sections as well as the middle section, though ordinarily this will not be necessary.

In the operation of this mechanism, the middle of the roll expands and contracts faster than the outer ends and it is for this reason that the roll or rolls are turned that it is initially formed concave to allow for expansion. After the rolls have been properly warmed up, the expansion takes up this concavity or clearance between the rolls, the faces of the two rolls are parallel to each other and conditions are normal. If the

rolls become heated too much, they become "puffed", that is, they are more expanded in the center than at the ends. Under these circumstances, steam is discharged toward the middle of the rolls and less steam is discharged toward the ends of the rolls or steam is entirely cut off from being discharged towards the ends of the rolls so that the middle portions of the rolls are slightly curled and thus contract. It will, therefore, be seen that our regulator is designed to control the shape of the rolls. The operator is not to exceed a temperature of 800° F., but under this temperature, he controls the temperature of the rolls to meet the condition of the material being rolled. At normal temperature, steam is used continuously.

We have before stated that the width of the material being rolled has to be decreased after a certain number of hours of operation. The reason for this is that after a certain width of material has been rolled continuously for a number of hours, shoulders are formed on the pair of rolls and under these circumstances, a narrower sheet must be rolled in order to keep the rolls in use. After the width of material is decreased, it is necessary to have a narrower regulator, that is, to use less of the length of the manifold, and this is secured by closing the two outside valves **25**. Thus this regulator is adapted to meet any conditions. These shoulders or bearings which are formed on the rolls are eventually turned off or ground off.

The bed plate C in our drawings is the extended foundation for the different mills. This bed plate is anywhere from fifty to three hundred feet long and the regulator or regulators may be moved or set anywhere along this bed plate, and the bar **50** may be swung to the left or right or any of the three adjustments named to be used. In place of steam, air may be ejected against the faces of the rolls to cool them and keep them in proper shape and in this case the air which is under compression is forced through the pipe **11** into the header **10** and into the manifold. This air under pressure passing out of the nozzles **21** and around the air inlet nozzles **28** draws air through the rear end of each nozzle so that a relatively small amount of compressed air will force a large amount of cool air out through the nozzles and toward the rolls. Under these circumstances, steam would not be used but one of the pipes **14** or **15** will be connected to a source of compressed air, the other pipe being connected to a source of gas for warming up the rolls. Under these circumstances, the damper plate with its dampers would not be used. The compressed air would not be heated but passing out through the injecting nozzles **21**, would draw air in through the pipes **28**, thus increasing the volume of air discharged against the rolls but reducing the amount of compressed air necessary before effecting the saving.

Attention is particularly called to the construction and shape of the nozzles **21** and **28**, as shown in Figure 3. This particular arrangement shown in Figure 3 provides for both an inspirating and mixing nozzle. The nozzle **21** has a tapered throat and the jet nozzle **28** is tapered to correspond while providing a proper clearance between the nozzles **28** and **21**, thus giving the nozzle **21** a Venturi effect. Steam is fed to the nozzles **21** from the interior of the manifold **16** and as it is discharged through the nozzle **21**, it travels around the brass jet nozzle **28** and is discharged at the tip of the nozzle **21**. The high velocity of the ring of steam surrounding the air nozzle **28** and discharged past the extremity of the nozzle **28** induces a flow of air which enters the large open end of the jet nozzle **28**, this air being discharged through the nozzle **28** and into the nozzle **21** where it is intimately mixed with the steam. Due to the high velocity of the steam passing through the nozzle **28**, a further entrainment of air takes place just exteriorly of the nozzle **21**. The combination of air and steam is driven forcibly against the rolls, thus cooling them. This combination of air and steam is particularly effective as the steam tempers the air and the tempering effect of the steam is beneficial in preventing too much chilling of the outer surface of the roll.

When it is necessary to heat the rolls, natural or manufactured gas is substituted for the steam and the induced air discharged through the nozzles **28** provides sufficient air for a combustion of the fuel giving a very intense flame at the nozzle tip when desired. By dividing the manifold up into sections with separate counters for each section, the rolls may be heated or cooled at desired locations. Thus it may be necessary to heat the middle portion of a roll while the end portions are being cooled because of the heat derived from the friction of the rolls on their bearings. As shown in Figure 1, valves **25** are provided for each of these sections so that the operator can vary the quantity of the tempered air for cooling or of gas for heating on each section independently of any other section. Our construction has the following advantages:

It provides for a quick change over from cooling to heating or vice versa;

It is adaptable to use in all type of mills and adjustable to any desired position.

The construction is particularly economical because the steam passing through the nozzles **21** draws in a large quantity of air, the steam simply tempering the air, and thus only a relatively small amount of steam is necessary in order to cool the rolls. If air under pressure was used alone, the use of compressed air would be costly but in our device, if compressed air is used, only a small amount of compressed air need be used in order to discharge this through the nozzles **21** because this small amount of compressed air would draw in a large amount of induced air through the nozzles **28**, thus rendering the mechanism particularly economical even when compressed air is used as a cooling medium.

While we have illustrated a particular embodiment of our invention which has been found in actual practice to be extremely effective, we do not wish to be limited to these details except as defined in the appended claims, as they may be changed in many ways without departing from the spirit of the invention.

What we claim is:

1. A temperature regulator for sheet rolls including a manifold having a plurality of discharge nozzles all extending in the same direction, means for connecting the manifold with a source of gas, means for connecting the manifold with a source of steam, valves for said connections, air nozzles open at both ends extending through the rear wall of the manifold and into the discharge nozzles, each air nozzle being spaced from the inner face of the corresponding discharge nozzle, a member mounted behind the air nozzles and carrying valves one for each discharge nozzle adjustable toward or from the open rear end of the air nozzle said member be-

ing shiftable to carry its valves out of position behind the air nozzles to thereby permit the free and unobstructed entrance of air thereto.

2. A temperature regulator for sheet rolls including a manifold having a plurality of discharge nozzles directed towards the rolls, means for connecting the manifold with a source of steam, means for connecting the manifold with a source of gas, air inlet nozzles extending through the manifold and into the discharge nozzles thereof, each air inlet nozzle being spaced from the inner face of the corresponding discharge nozzle, a member slidably mounted behind the air nozzles but spaced therefrom, said member carrying a plurality of valve stems, and valves coacting with the rear ends of the air nozzles, the stems being adjustable to carry the valves nearer to or further from the air nozzles, said member between the valves having air openings, the member being shiftable to carry the valves into alinement with the air nozzles or carry the openings in the member into alinement with the air nozzles.

3. A temperature regulator for sheet rolls including a manifold having discharge nozzles directed towards the rolls, valved means for connecting the manifold with a source of steam, valved means for connecting the manifold with a source of gas, air nozzles extending through the manifold and into the discharge nozzles, each air nozzle being spaced from the inner face of the corresponding discharge nozzle, opposed lugs extending from the manifold opposite each discharge nozzle, the lugs having slots in the inner faces, a plate slidably mounted in said slots and having a series of air openings at spaced intervals, valve stems having screw threaded engagement with the plate and disposed between said air openings, and valves carried by said stems and movable thereby toward or from the rear ends of the air nozzles, the plate being shiftable to bring either the valves or the openings into alinement with the air nozzles.

4. A temperature regulator for sheet rolls including a manifold having discharge nozzles directed towards the rolls, valved means for connecting the manifold with a source of steam, valved means for connecting the manifold with a source of gas, air nozzles extending through the manifold and into the discharge nozzles, each air nozzle being spaced from the inner face of the corresponding discharge nozzle, opposed lugs extending from the manifold opposite each discharge nozzle, the lugs having slots in the inner faces, a plate slidably mounted in said slots and having a series of air openings at spaced intervals, valve stems having screw threaded engagement with the plate and disposed between said air openings, valves carried by said stems and movable thereby toward or from the rear ends of the air nozzles, the plate being shiftable to bring either the valves or the openings into alinement with the air nozzles, and means limiting the movement of the plate to a distance equal to the distance between the center of one of the openings and the center of the next adjacent valve and equal to the distance between the axial centers of the air nozzles.

5. A temperature regulator for sheet rolls including a base, a horizontal arm operatively supported for adjustment on the base, a vertical supporting rod extending through the end of the arm and adjustable vertically through the arm, a bracket pivotally mounted upon the upper end of the supporting rod and having a clamp at its upper end, means carried by the bracket and engaging the supporting rod for adjusting the bracket around its pivot, a pipe carried by said clamp, a header into which said pipe opens, a manifold extending parallel to the header, a plurality of pipe connections between the header and the manifold and including a valve, the manifold being provided with a plurality of radially directed nozzles, a plurality of air nozzles extending through the manifold and into the first named nozzles but spaced therefrom, and means individual to each air nozzle for controlling the amount of air passing into the rear end of said nozzle.

6. The combination with upper and lower sheet rolls, of a temperature regulator therefor including a manifold having a plurality of radial discharge nozzles directed toward the rolls, separately controllable means for supplying said manifold with gas or with steam, air nozzles extending through the manifold and into the discharge nozzles, the forward ends of the air nozzles terminating short of the outlet extremities of the discharge nozzles, the rear ends of the air nozzles being open, means individual to each air nozzle for controlling the amount of air passing into the nozzle, a base disposed below and in advance of the lowermost roll, and means adjustably mounted upon said base for supporting the manifold in any one of a plurality of positions whereby the discharge nozzles of the manifold may be directed toward either of the rolls or toward the nip between the rolls.

7. A temperature regulator for sheet metal rolls including a manifold having a middle chamber and two end chambers, the two end chambers having inlet openings and a plurality of nozzles extending in the same direction, the middle chamber having a plurality of inlet openings and a plurality of nozzles extending in the same direction as the first named nozzles, the end chambers of the manifold being closed except for the inlet openings and the nozzles, a plurality of air nozzles extending through the rear of the manifold and into the discharge nozzles of this middle section of the manifold but spaced therefrom, the rear ends of the air nozzles being open, means for controlling the amount of air entering through said air nozzles, a header, pipe connections between the header and the lateral chambers of the manifold and between the header and the middle chamber of the manifold, valves in said pipe connections, means whereby the header may be connected either with a source of gas or with a source of steam, and means for adjustably supporting the header and the pipe connections thereof permitting the angle of the discharge nozzles to be changed relative to a horizontal plane.

8. A temperature regulator for sheet metal rolls including a tubular manifold having a plurality of tapering radial discharge nozzles, a plurality of tapering jet nozzles extending through the rear wall of the manifold and extending part way into the manifold nozzles but spaced therefrom, the outlet ends of the air nozzles terminating short of the outlet ends of the discharge nozzles, separately controlled means for admitting either cooling fluid or gas into the interior of the manifold whereby the manifold may be used for either cooling or heating the rolls, and means for controlling the amount of air passing into the rear end of the jet nozzles.

9. In combination with the rolls of a sheet metal rolling mill, of a temperature regulator for the rolls including a manifold extending approx-

imately parallel to and having a plurality of tapering discharge nozzles discharging toward the rolls, a plurality of tapering air nozzles extending through the rear wall of the manifold but spaced from the interior face thereof, the outlet ends of the air nozzles terminating short of the outlet ends of the discharge nozzles, means for connecting the interior of the manifold either with a source of cooling fluid or with a heating gas, independently operable valves for controlling the admission of the gas or the cooling fluid to the interior of the manifold, and means for supporting the manifold for adjustment in a vertical plane or horizontal plane or angularly.

10. A roll temperature regulator for sheet mills, including a manifold having a plurality of radial nozzles, a plurality of air nozzles extending through the rear wall of the manifold and having gas-tight engagement with said rear wall, the air nozzles being tapered toward their discharge ends and being less in diameter than the discharge nozzles, the air nozzles terminating at their outlet ends short of the outlet ends of the discharge nozzles, means for controlling the air entering said air nozzles, and means for connecting the manifold either with a source of cooling fluid or a source of gas.

11. A temperature regulator for sheet metal rolls, including a manifold having a plurality of radial discharge nozzles, a plurality of air nozzles having gas-tight engagement with and extending through the rear wall of the manifold, the air nozzles being tapering and less in diameter than the discharge nozzles and terminating at their outlet ends short of the outlet ends of the discharge nozzles, a header extending parallel to the manifold, a plurality of valve controlled pipes spaced from each other along the header and extending into the manifold, a pipe leading from the middle of the header, and means for connecting said pipe either with a source of cooling fluid or a source of gas.

12. A temperature regulator for sheet rolls, including a manifold having discharge nozzles extending radially outward from and projecting beyond the manifold and directed all in the same direction toward the rolls, means for connecting the manifold with a source of steam, means for connecting the manifold with a source of gas, each of said means having an independently controllable valve, air admitting nozzles open at both ends and extending into the rear wall of the manifold, through the manifold and into the discharge nozzles, the discharge nozzles and the air inlet nozzles being tapered, the air inlet nozzles terminating short of the outlet ends of the discharge nozzles, each air nozzle being spaced from the interior face of the corresponding discharge nozzles, and means for controlling the flow of air through the rear ends of the air nozzles.

EARL F. SPENCE.
LOUIS T. LINDQUIST.