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METAL FORMING

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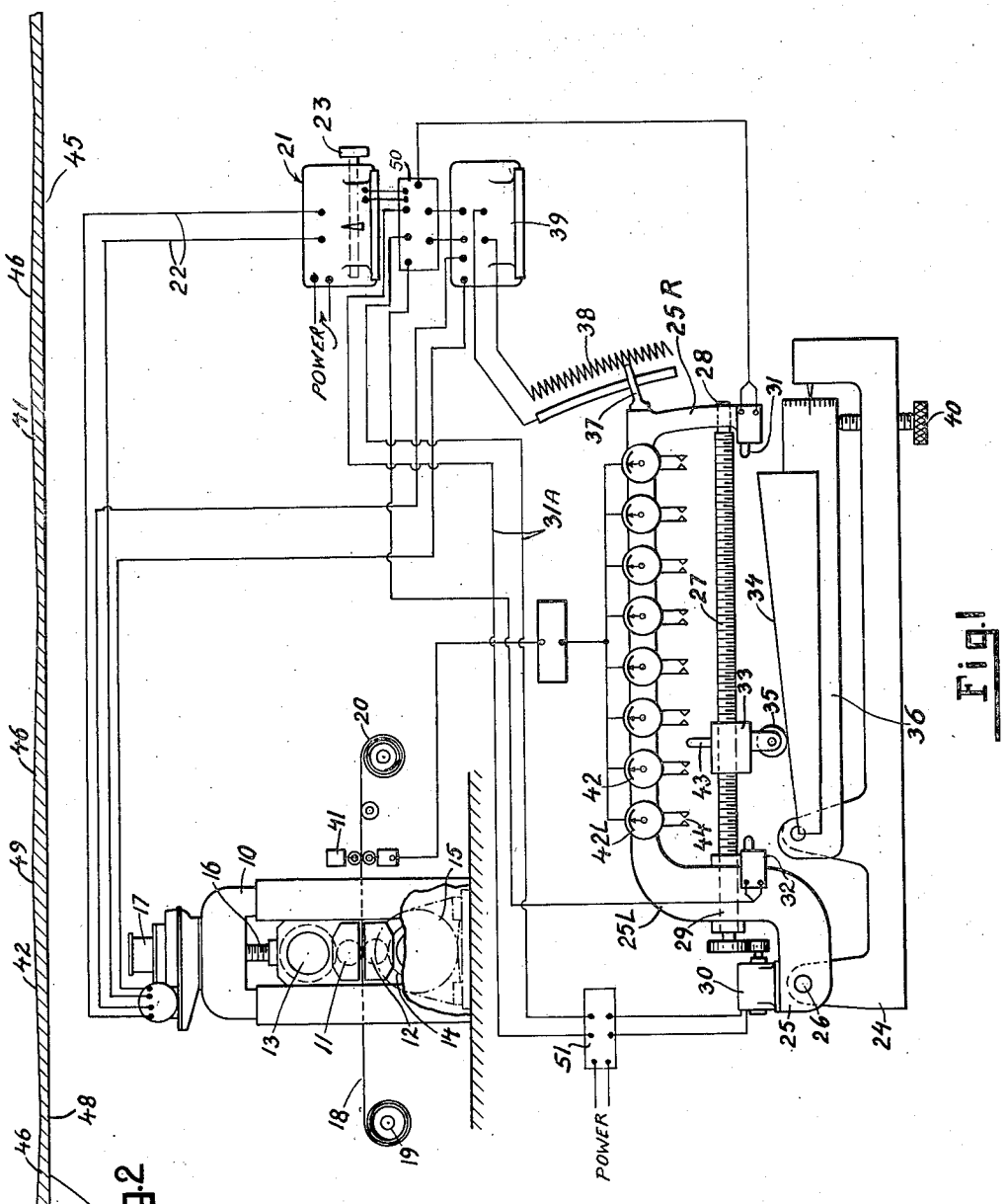

Fig. 1

Fig. 2

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METAL FORMING

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This invention relates to the rolling of tapered sheets from flat sheets and particularly to an apparatus for controlling accurately the taper and sheet thickness.

It is not possible to produce satisfactorily tapered sheets by merely passing the sheet at a constant speed through a rolling mill while at the same time operating a roll pressure varying or screw-down mechanism at a constant speed. One of the reasons for this is that the mill parts will deflect and such deflection will be variable.

One of the objects of the present invention is to provide an apparatus which will produce a uniformly tapered sheet regardless of mill deflection and other factors such as temperature differentials of parts of the mill.

Another object of the invention is to provide an apparatus which can be employed to roll various predetermined tapers on sheets.

In one aspect of the invention, a conventional rolling mill can be employed having the usual working and backing rolls mounted in bearing blocks or chocks in the mill housings. The roll pressure changing or screw-down mechanism can be connected to the chocks for changing the pressure on the chocks for changing the pressure on the rolls and thus the the thickness of the material being rolled as it is passed through the mill. The screw-down mechanism can have a quick reversible motor for operating the same, the motor being driven at the desired speed in each direction for predetermined intervals to produce the required taper. The interval is properly related to the mill speed so as to produce the desired taper in conjunction with the corrective or taper control compensating means described hereafter. When the pressure on the rolls is decreased by the screw-down motor operating in a roll pressure decreasing direction, the strip being rolled will increase in thickness. At a predetermined time, the direction of the screw-down motor can be reversed and the screw-down mechanism operated in a pressure increasing direction which will serve to gradually reduce the thickness of the sheet being rolled. Mill deflection, however, will be present in a variable amount so that merely constantly driving the screw-down motor in either direction will not produce a uniformly tapered sheet. A taper or contour corrective or compensating arrangement is provided for correcting the speed of the screw-down mechanism from its basic speed to a speed changing a predetermined amount at the times or places required so as to produce a uniformly tapered sheet. The corrective or compensating arrangement also can

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be arranged so that the screw-down mechanism will be reversed automatically at predetermined intervals so that an increasing and decreasing taper will be produced on the sheet each complete cycle of the screw-down mechanism. The sheet then can be cut to produce two sheets having the same taper. In addition to rolling continuously sheets of predetermined taper, the corrective mechanism also can be arranged to roll sheets of predetermined changing taper.

In a further aspect of the invention, a gauge mechanism responsive to the rolled sheet thickness can be employed together with a plurality of successive "null" type or zero reading gauges successively energized and set so as to indicate whether or not the taper involved is correct.

These and other objects, advantages, and features of the invention will become apparent from the following description and drawings which are merely exemplary.

In the drawings:

Fig. 1 shows a diagrammatic arrangement for carrying out the invention together with one form of corrective or compensating mechanism.

Fig. 2 shows a section of sheet illustrating the manner in which the taper is formed on a sheet passed through a mill.

The rolling mill shown is merely for purposes of illustration and is conventional. Housing 10 may have working rolls 11 and 12 with the usual backing rolls 13 and 14, the mill being driven by constant speed motor 15 as is known. The thickness of the material after rolling depends upon the pressure with which the rolls are urged toward each other. Screw-down mechanism 16 engages the roll carrying chocks for the upper roll 13 in the usual manner. The screw-down mechanism 16 may be driven by a conventional motor 17, said motor preferably being of the quick reversing type. It may have its speed and direction changed in any of the usual manners.

The sheet 18 to be rolled is fed from pay-off roll 19 through the mill and onto wind-up reel 20, its speed being maintained uniform on the delivery side. The direction and speed of screw-down motor 17 and motor 30 can be controlled by a reversing mechanism 50 of conventional type which can be connected by suitable leads to the basic speed control mechanism 21, to carriage motor control 51, and to the compensating control 39. Basic speed control mechanism 21 can be connected by leads 22 to motor 17. Operation of the reversing mechanism is effected by the control apparatus described hereafter. Speed adjusting means 23 of the basic speed mecha-

nism, which can consist of the usual rheostat, can be used to set the basic speed of operation of screw-down motor 17 in accordance with the sheet speed.

Reversing mechanism 50, operated as described hereafter, can operate relays in mechanism 21 to change direction of power in leads 22 to motor 17.

The corrective control operating apparatus for predeterminedly changing the basic screw-down motor speed may comprise a frame 24 having an arm or yoke 25 pivoted thereon, said arm being pivoted at 26. The arm 25 may carry a screw-threaded rod or lead screw 27 which can be rotatably supported in frame 25 in bearings at 28 and 29.

Reversible accurately adjustable constant speed motor 30 can be energized by adjustable constant speed power supply control means 51 which is reversible. Carriage 33 is moved between legs 25L and 25R of arm 25 by the lead screw 27 in accordance with the direction of rotation thereof by motor 30.

Assume, for example, that the carriage starts from adjacent 25L and moves toward 25R. When it reaches the right hand end, reversing switch 31 will be operated which will actuate relays in reversing control means 50, which in turn will operate relays in constant speed control 51 through leads 31A. At the same time, screw-down motor 17 will be reversed through actuation of 21. When the carriage reaches the left end of the apparatus adjacent leg 25L, reversing switch 32 will be operated again to actuate reversing control 50 so as to reverse motor 30 as well as screw-down motor 17. Thus, carriage 33 will reverse the screw-down motor at predetermined intervals. The speed of the screw-down mechanism can be adjusted in relation to the constant speed of the strip through the mill to give the desired taper to the sheet.

As previously mentioned, this taper will not be correct because of the variable deflection of the mill and other factors. A correction of the speed of screw-down motor must be made in accordance with a predetermined program or pattern.

One manner in which this can be accomplished is to provide a template or cam 34 upon which follower or roller 35 of carriage 33 rides. Inasmuch as arm 25 is pivotally mounted on frame 24, it can be seen that it will be given angular movement in accordance with the cam 34. A contactor 37 mounted on arm 25 can operate with resistor or controller 38 to produce a signal functionally related to the cam 34 and the position of the carriage 33 relative thereto. The signal can be fed to conventional compensating speed control means located at 39 which in turn can be connected with screw-down motor 17, the speed control means furnishing a corrective control current or voltage to the motor 17. The corrective current cooperates with the main basic speed control current from control 21 to produce the desired speed and thus the desired taper. The reversing control 50 also is connected to compensating control 39 and operates suitable relays therein to reverse the direction of the compensating control current fed to screw-down motor 17. For example, motor 17 may have a pair of fields supplied by the basic speed current and the corrective current.

The cam 34 can be made straight or any other desired shape to produce the required taper. When a straight taper is involved, the cam is not necessarily straight. The shape may vary in accordance with the characteristics of the mill and the thickness being rolled. If other than a straight taper is involved, the cam can be shaped as required. The cam may be mounted on adjustable arm 36 which is pivoted to frame 24 and adjustably positioned by knob 40. Thus, small variations in final taper thickness can be corrected by adjustment of knob 40.

In order to visually check the taper being rolled, a gauge 41 can be used to furnish a signal successively indicative of sheet thickness to the various gauges located on frame 25. The gauges 42 on frame 25 may be of the so-called "null" type which can be adjusted so that they will show zero if the taper, thus the thickness, is correct at each successive point concerned. The thickness gauge 41 may be one known as the "Electro-Limit" gauge such as manufactured by the Pratt & Whitney Co., of Hartford, Conn. Carriage 33 has a contact finger 43 thereon which will successively close contacts 44 of each gauge to sequentially energize the gauges 42L and succeeding gauges 42. If the taper and thickness is correct at the particular point, the particular null gauge can be set to read zero. If a gauge shows an incorrect thickness, it will show a plus or minus reading. The speed setting mechanism 23 then can be operated so as to increase or decrease the speed of the screw-down motor. Inasmuch as the strip is passing at a constant speed through the mill, the taper will be adjusted thereby. It may be, of course, that knob 40 will require adjustment or that a different cam 34 will be required. If gauge 42L shows a variation from the predetermined desired thickness at the point of maximum sheet thickness, then basic speed control knob 23 can be corrected to produce the correct thickness at the succeeding cycle of operation. If 42L shows the correct thickness and then if succeeding gauges have incorrect readings in the same direction, then knob 40 can be adjusted.

As an example of the shape of the sheet rolled by the present invention, reference may be made to Fig. 2 wherein sheet 45 has alternate decreasing tapers 46 and increasing tapers 47. The reversing points of the screw-down motor are at 48 and 49 at which points the sheet can be cut to produce a plurality of similarly shaped sheets.

It is to be understood that various details in construction can be made without departing from the spirit of the invention except as defined in the appended claims.

What is claimed is:

1. In corrective speed means for a screw-down mechanism of a mill for rolling tapered sheet, said mill having a screw-down mechanism controlling pressure applied to rolls of said mill, the combination including a pivoted arm, a carriage movable back and forth on said arm, a cam, cam follower means on said carriage contactable with said cam, said arm being movable by said cam and follower means as said carriage is moved back and forth on said arm, and control means operated by the movement of said arm to control a corrective speed source of energy for said screw-down mechanism.

2. In corrective speed means for a screw-down mechanism of a mill for rolling tapered sheet, said mill having constant speed drive means and a screw-down mechanism controlling pressure applied to rolls of said mill, the combination including a pivoted arm, a car-

riage movable back and forth on said arm, a cam, means adjustably holding said cam relative to said arm, cam follower means on said carriage contactable with said cam, said arm being movable by said cam and follower means as said carriage is moved back and forth on said arm, and control means operated by the movement of said arm to control a corrective speed source of energy for said screw-down mechanism.

3. In corrective speed and indicating means for a screw-down mechanism of a mill for rolling tapered sheet, said mill having a screw-down mechanism controlling pressure applied to rolls of said mill, the combination including a pivoted arm, a carriage movable back and forth on said arm, a cam, cam follower means connected with said carriage contactable with said cam, said arm being movable by said cam and follower means as said carriage is moved back and forth on said arm, control means operated by said movement to control a corrective speed source of energy for said screw-down mechanism, signal means responsive to thickness of rolled sheet, and a plurality of gauge operating means at spaced intervals along said arm, each connectable successively with said signal means as the carriage passes thereby, so as to give an indication of the thickness at predetermined points in the tapered sheet being rolled.

4. In corrective speed means for a screw-down mechanism of a mill for rolling tapered sheet, said mill having constant speed drive means and a screw-down mechanism controlling pressure applied to rolls of said mill, the combination including a pivoted arm, a carriage movable back and forth on said arm, a cam, cam follower means on said carriage contactable with said cam, said arm being movable on its pivot by said cam and follower means as said carriage is moved back

and forth on said arm, and means operated by said movement to control a corrective speed source of energy for said screw-down mechanism, signal means responsive to thickness of the sheet after it is rolled, a plurality of spaced null-type gauge operating means along said arm, and means on said carriage successively connecting said gauge operating means with said signal means, the gauges being settable so each will read zero when it is connected to the signal means if the taper rolled is correct.

5. In corrective speed means for a screw-down mechanism of a mill for rolling tapered sheet, said mill having constant speed drive means and a screw-down mechanism controlling pressure applied to the rolls of said mill, the combination including a pivoted arm, a carriage movable back and forth on said arm, a cam, cam follower means on said carriage contactable with said cam, said arm being movable by said cam and follower means as said carriage is moved back and forth on said arm, and means operated by the movement of said arm to control a corrective speed source of energy for said screw-down mechanism, a reversible constant speed motor driven lead screw on said arm for moving said carriage, and reversing switches connected to the motor of said motor driven lead screw adjacent the ends of travel of said carriage to cause reversal of the carriage at predetermined intervals.

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