

March 10, 1959

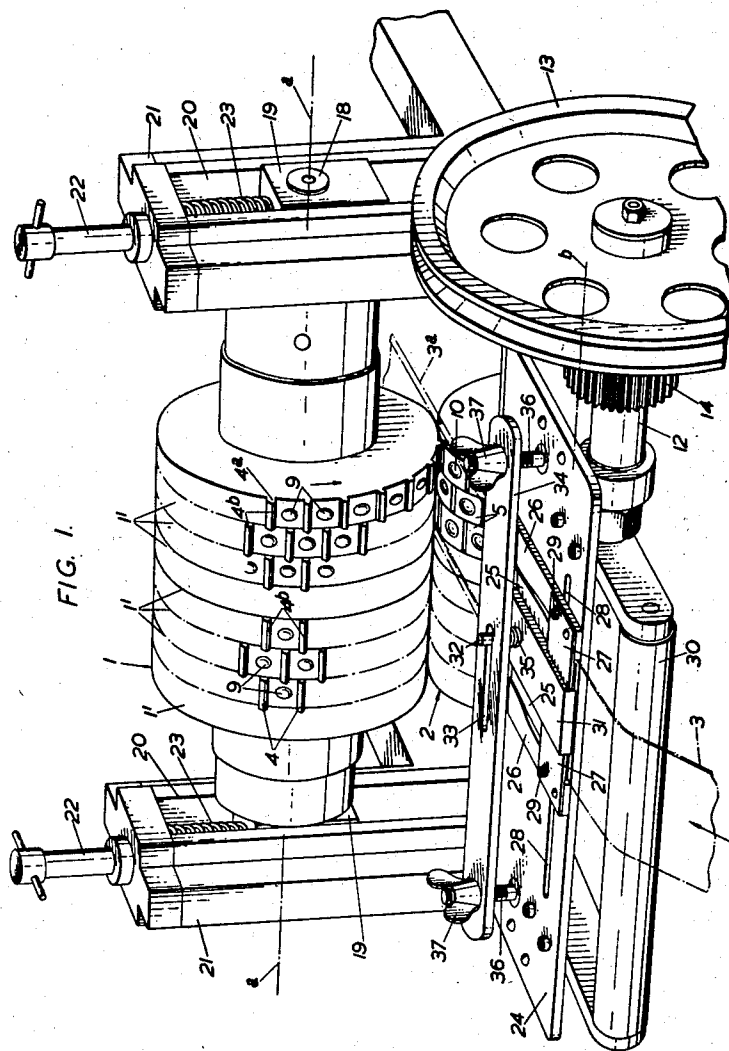
J. W. LAWRENCE

2,876,723

MACHINE FOR PRODUCING FINS FOR FINNED TUBE CORE STRUCTURES

Filed May 22, 1953

6 Sheets-Sheet 1



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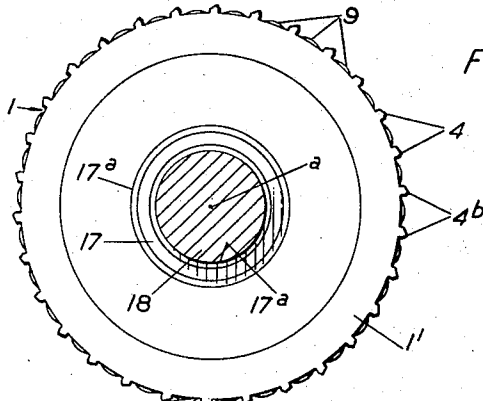


FIG. 2.

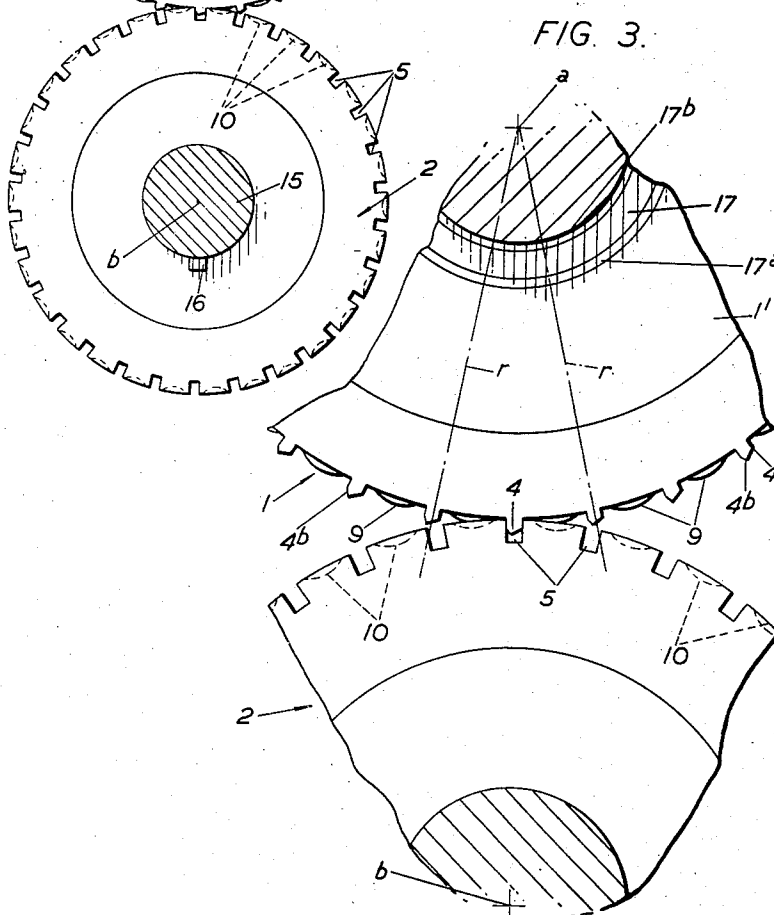


FIG. 3.

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FIG. 4.

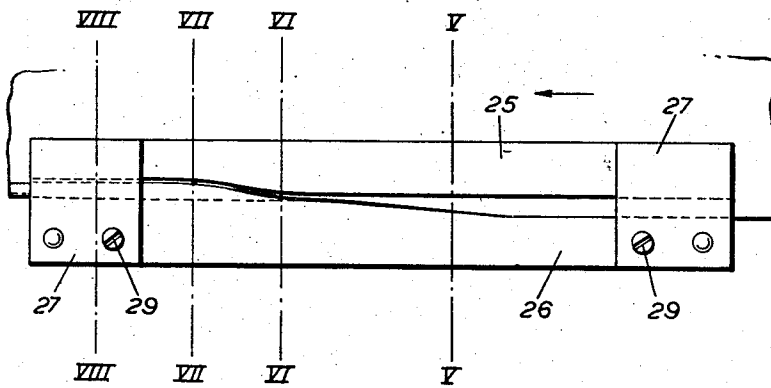


FIG. 5.

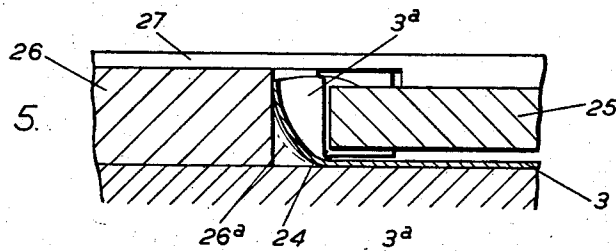


FIG. 6.

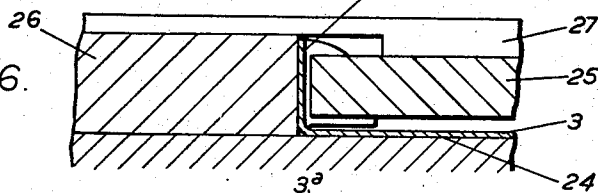


FIG. 7.

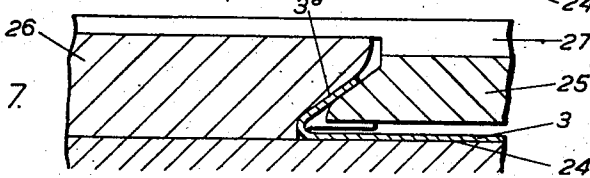
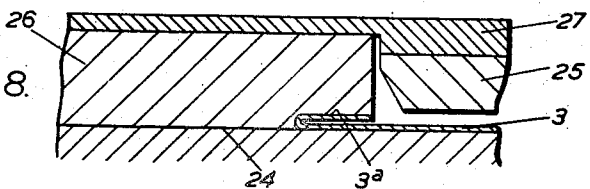


FIG. 8.



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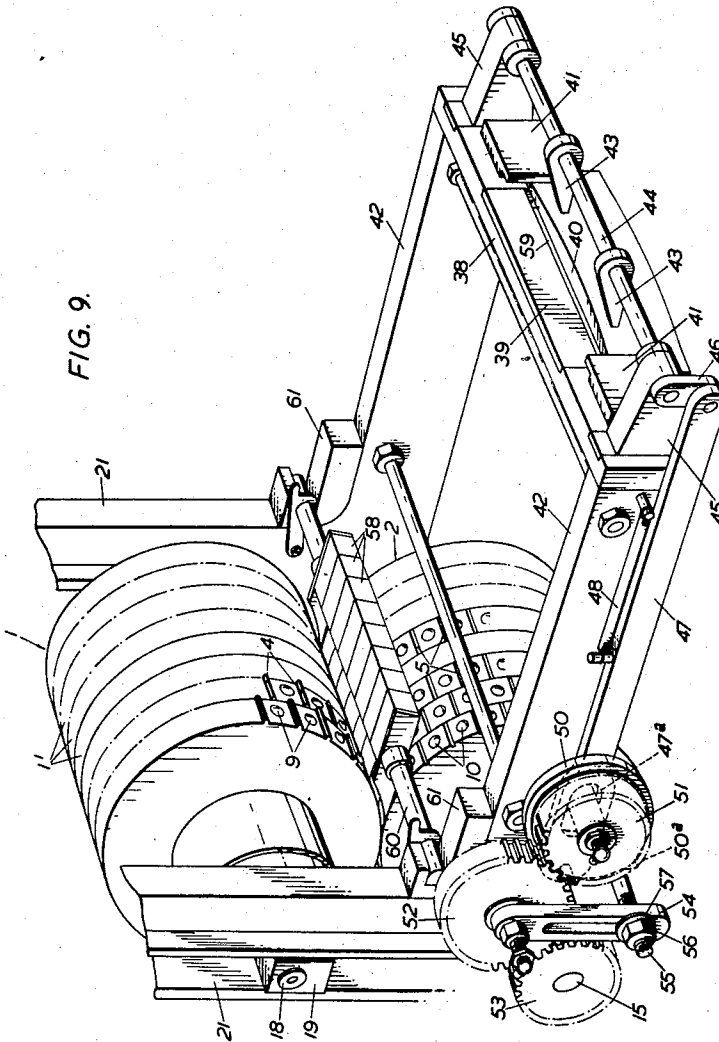
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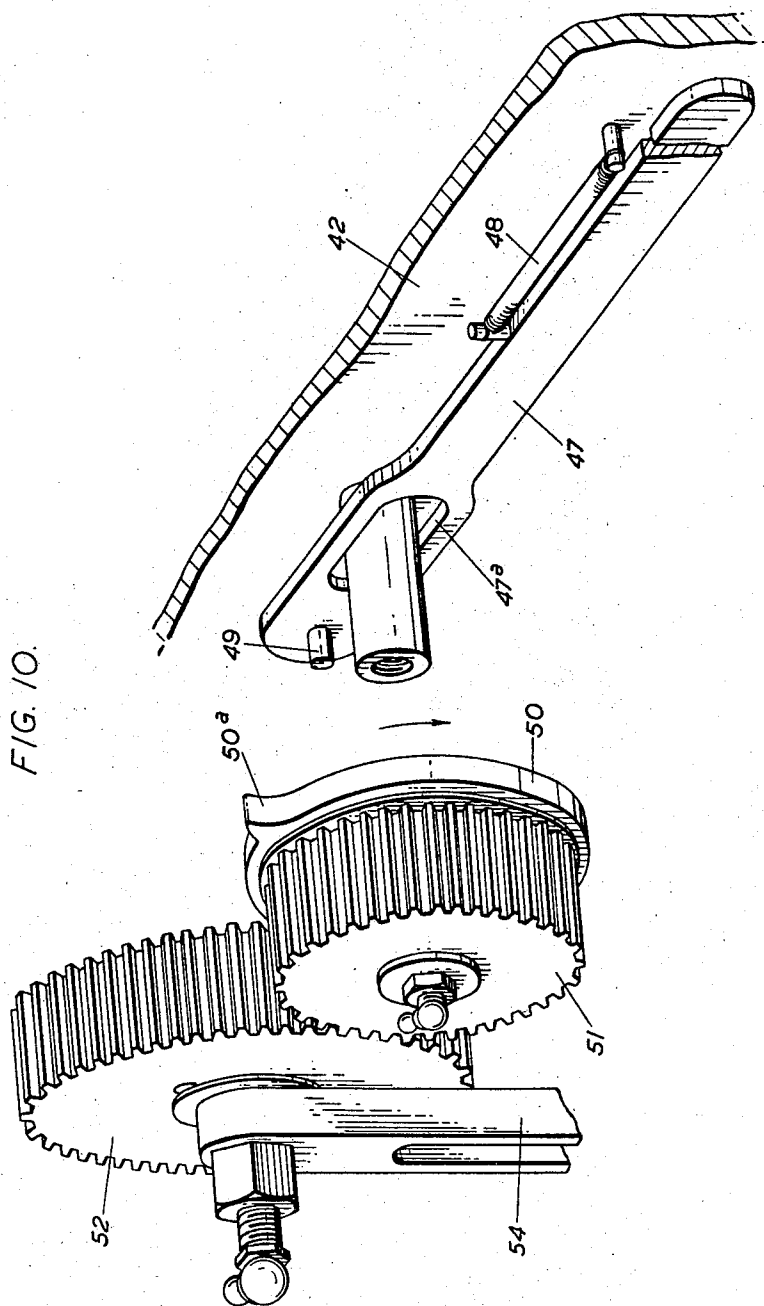
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FIG. 12.

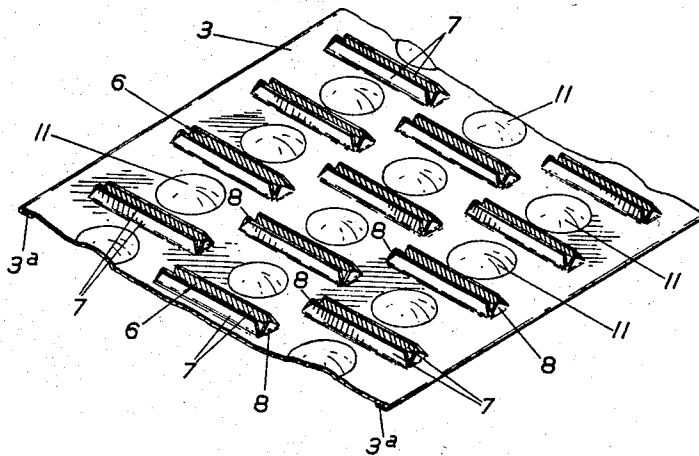


FIG. 11.

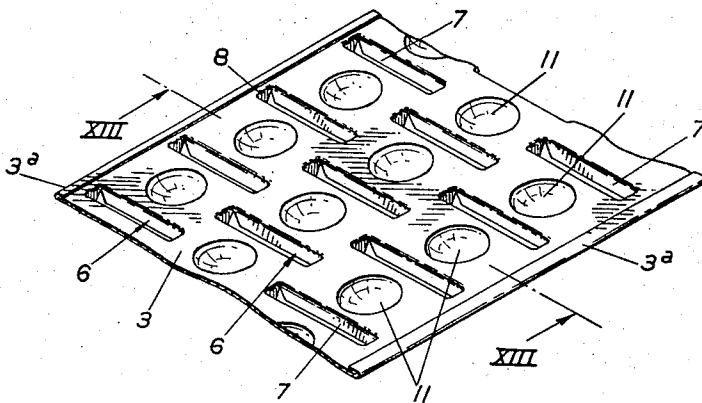
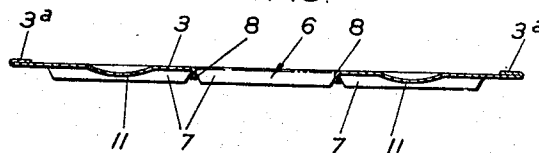


FIG. 13.



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MACHINE FOR PRODUCING FINS FOR FINNED TUBE CORE STRUCTURES

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2 Claims. (Cl. 113—1)

This invention relates to machines for producing fins for use in the construction of core structures of the finned tube type.

Finned tube core structures are embodied in heat exchange apparatus such, for instance, as radiators for use in conjunction with liquid cooled internal combustion engines, and are alternatively known as cores of the "gilled tube" or "fin and tube" type.

A finned tube core structure comprises a plurality of tubes, usually of a flat or oval section, these tubes extending through spaced fins adapted to provide heat dissipating or radiating surfaces.

Conventional methods of producing these fins involve the use of a large power press equipped with a press tool of the pierce and plunge type combined with attachments such as an edge folding device, a guillotine and an automatic roll feed. The output of such known presses, as well as their capital cost, is high, and as a consequence their use is confined to large undertakings.

The object of the present invention is to provide a comparatively small fin-producing machine of low capital cost which is adjustable in a simple manner to enable fins of various widths and lengths to be economically produced at a rate more suited to the needs of the small manufacturer.

The machine constituting this invention essentially includes a pair of co-operable and drivable rollers arranged to act on and feed forward an initially flat strip of relatively thin and easily deformable metal introduced between them, the said rollers being provided with appropriately disposed interengageable and complementary formations adapted so to pierce and deform the fed strip as to produce therein peripherally flanged openings.

The openings so produced are, of course, those through which the flat or oval section tubes are ultimately inserted during assembly of a core structure.

Of the pair of co-operable rollers, one (preferably the top one) is a male roller formed with appropriately disposed and shaped teeth constituting punches, whilst the other (preferably the bottom one) is a female roller having formed therein correspondingly disposed and complementarily shaped recesses.

With the object of producing, in the fed strip from which the fins are cut, additional formations designed to create greater air turbulence and thereby increase heat dissipation, the co-operable rollers in the improved machine may, in accordance with another feature of this invention, be provided with further complementary formations designed to produce in the strip air deflecting protuberances. Thus, these additional formations, of which there may advantageously be one in each portion of each roller encompassed by a group of teeth (or recesses), may be adapted to produce in the fed strip circular and shallow imperforate protuberances.

In advance of the aforementioned co-operable rollers there may be conveniently be provided an edge folder or hemming attachment through which the strip material in its initially flat, uncut and unpressed condition can

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be drawn by the said rollers. Such a folder may be of any suitable conventional "plough-share" form adapted to bend over and fold down the longitudinal edges of the strip as it is drawn from the supply.

On the side of the rollers remote from the edge folder there may be provided a guillotine which is operable automatically to cut from the continuously issuing rolled strip fins of any desired length.

In order that the invention may be more clearly understood, a specific constructional example of the fin-producing machine so far only broadly defined, and a portion of a fin produced thereby, will now be described with reference to the accompanying drawings, wherein,

Figure 1 is a general perspective view of the co-operable rollers and of the edge folder provided in advance thereof,

Figure 2 is a side view of the rollers per se,

Figure 3 is a fragmentary detail view of portions of the said rollers showing the punch teeth and the complementary recesses more clearly,

Figure 4 is a detail plan view depicting one side of the edge folder,

Figures 5-8 are cross-sectional views drawn to an enlarged scale and taken on the lines V—V, VI—VI, VII—VII and VIII—VIII of Figure 4 respectively, these views serving to illustrate the manner in which the longitudinal edge of the strip material is bent over and folded down,

Figure 9 is a general perspective view of the automatically operable guillotine,

Figure 10 is a detail perspective view of the gearing whereby a cam for operating the guillotine is driven.

Figure 11 is a perspective view of the upper side of a fragmentary portion of a fin as it comes off the fin-rolling machine,

Figure 12 is a similar view of the upper side of the fin, and

Figure 13 is a cross-sectional view of the fin taken on the line XIII—XIII of Figure 11.

Like parts are designated by similar reference characters throughout the drawings.

Referring to Figures 1, 2 and 3, it will be seen that the machine includes a pair of rollers 1 and 2 disposed to revolve about horizontal axes and so arranged as to be adapted to act on and feed forward an initially flat strip 3 (Figure 1) of thin and easily deformable metal, e. g. copper, introduced between them. The top roller 1 is a male roller formed with suitably shaped teeth 4 in the nature of punches, whilst the bottom roller 2 is a female roller having formed therein complementarily shaped recesses 5. The teeth 4 and the complementary recesses 5 are straight and extend parallel to the axes *a* and *b* of rotation of the rollers 1 and 2, that is to say at right angles to the ends of the latter. Moreover, the said teeth 4 and recesses 5 are regularly spaced apart and arranged in straight rows, the teeth (and recesses) in alternate rows being staggered in relation to the teeth (and recesses) in the intervening rows to the extent of half the pitch of the teeth and recesses. This will be apparent from Figure 1 and quite clear from Figures 8 and 9 wherein are depicted the peripherally flanged openings or slots 6 produced in the strip 3 by the entrance of the teeth 4 into the recesses 5. Each punch-like tooth 4 is flat at its opposite ends 4*a* and is so bevelled at its sides as to have a straight comparatively sharp cutting edge 4*b*. As will be evident from a consideration of Figure 3, the bevel at one side of each such tooth is more steeply inclined than the bevel at the other side, and the line of intersection of the two bevelled surfaces is offset, e. g. to the extent of approximately .019" with respect to a radial plane *r* extending through the axis *a* of the male roller 1 and the median line of the root of the

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tooth. The shape of the tooth is such as to pierce the strip 3 and form therein a narrow rectangular opening 6 which is flanked at its sides with trapezoidal flanges 7 and has at its ends triangular lips 8 disposed in planes at right angles or substantially so to the plane of the strip 3.

The surface of the roller 1 may, as shown, have formed thereon, in addition to the teeth 4, circular and partly spherical protuberances 9 disposed in the spaces between the teeth, and these protuberances are complemented by shallow cup-like hollows 10 formed in the female roller 2. The hollows 10 lie in the spaces between the straight, narrow recesses 5 and, as the initially flat metal strip 3 passes between and is fed forward by the rollers 1 and 2, the circular protuberances engage in the complementary hollows 10 and press into the strip imperforate air deflecting protuberances 11 (see Figures 11, 12 and 13) each of which is encompassed by a group of the peripherally flanged openings or slots 6.

Either or both of the rollers 1 and 2 may be driven, e. g. from an electric motor, through the medium of reduction gearing. Preferably, however, only the female roller 2 is positively driven and in this regard the main driving shaft of the machine is indicated at 12 in Figure 1. To one end of this shaft is rigidly secured a pulley 13 arranged to be driven from an electric motor (not shown), and combined drive-transmitting and reduction gearing, including a spur gear 14 on the said shaft, is provided between the latter and the shaft 15 (Figures 2 and 9) of the bottom roller. The gear 14 meshes with a gear on a lay shaft (not shown) which extends right across to the opposite side of the machine where the reduction gearing is located. The roller 2 is keyed at 16 to the shaft 15.

To provide for variation of the width of the fins to be produced by the improved machine, one of the co-operable rollers may be of a fixed length commensurate with a fin of maximum width, whilst the other roller may be made up of a plurality of co-axial disc-like sections the number of which can be varied to correspond with the width of the fin required. For example, in the specific form of the machine illustrated in the drawings, the top roller 1 is made up of separate toothed discs 1¹. A rubber or equivalent bush or sleeve 17, interposed between relatively thin concentric rings 17a and 17b, is provided between each separate toothed disc 1¹ and the shaft 18 of the male roller 1. The purpose of the bushes or sleeves 17 is to absorb the shock of engagement of the teeth 4 and the protuberances 9 in the recesses 5 and the hollows 10, and also to ensure that the said teeth make accurate line contact with the strip 3. The separate toothed discs 1¹ are adapted to be slidably engaged with and readily removed from the top roller shaft 18, according to requirements, the complete assemblage of discs being clamped between collars adapted to be fixed upon the shaft.

Moreover, the rollers 1 and 2 may be movable one or each in relation to the other, for the purpose of varying, if necessary, the pressure on the fed strip 3. In the specific example illustrated the ends of the shaft 18 of the upper roller 1 are mounted in bearing blocks 19 which are in turn mounted slidably in vertical slots 20 in a structure 21 with which are associated manually operable screw means such as 22 for adjusting the positions of and varying the pressure on these blocks, according to working requirements. Compression springs 23 are interposed between the screw means and the blocks 19.

The edge folder or hemming attachment provided immediately in advance of the co-operable rollers 1 and 2 is mounted on a flat, horizontally disposed base plate 24 (Figure 1). The edge folder comprises two spaced pairs of folder elements 25 and 26, the elements of each pair extending closely side by side in the direction of travel of the metal strip 3. The inner element 25 of each pair is held in a raised position slightly above the top surface

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of the base plate 24 so that the appropriate marginal edge portion of the fed strip can pass beneath it. The adjacently disposed outer folder element 26 of the pair fits down flat upon the plate 24, and the two elements are held together in the correct co-operative relationship by square connector plates 27. These plates are secured upon the tops of the end portions of the folder elements 25 and 26, as illustrated more clearly in Figure 4, and serve to carry the inner elements 25 which may conveniently be rivetted thereto. The opposed edges of the folder elements of each pair are suitably spaced apart and so contoured as to turn up, bend over and fold down the relevant marginal edge portions of the strips 3 in a progressive manner as it is drawn from the supply. Successive stages in the folding or hemming of an edge will now be briefly described with reference to Figures 5-9. In Figure 5, a marginal edge portion 3a of the strip 3 is shown in the course of being acted upon and turned up by a suitably profiled portion 26a of an outer folder element 26; this takes place at the station V-V in Figure 4. In Figure 6, the edge portion 3a, passing through the station VI-VI, is vertically disposed and located in a narrow space between the opposed folder elements 25 and 26. By the time the turned-up edge portion progresses to the station VII-VII, it has been bent over onto the inner element 25 by the element 26 in the manner depicted in Figure 7. Finally, and at the station VIII-VIII immediately preceding entry of the strip into the nip of the rollers 1 and 2, the outer folder element 26 functions to fold down the bent-over edge flat upon the strip as shown in Figure 8. The pairs of folder elements are made adjustable laterally towards and away from each other to vary the width of the edge folder, in which connection the base plate 24 has formed therein transversely extending slots 28 through which extend clamping screws or bolts 29 associated with the folder elements. It is, of course, necessary to effect a corresponding variation in the width of the edge folder whenever the width of the top roller 1 is varied.

Beneath, and slightly in front of the leading edge of the base plate 24 is a freely rotatable supporting roll 30 which acts to support and guide the metal strip 3 at the location where it enters the edge folder.

Mounted between the two laterally spaced pairs of folder elements 25 and 26 is a brake 31 in the form of a flat rectangular plate or bar the underside of which is faced with leather or the like. As shown in Figure 1, this brake is furnished with an upstanding pin 32 which projects up through a slot 33 formed in a transversely arranged pressure bar 34. A compression spring 35 arranged to surround the pin 32 is interposed between the underside of the bar and the top of the brake. The central slotted portion of the bar 34 rests on the top of the spring 35 whilst the ends of this bar are drilled and engaged over pins 36 extending vertically upwards from the base plate 24. The said pins are screw-threaded to receive wing nuts 37 by means of which the downward pressure exerted by the bar 34 upon the brake 31, through the medium of the spring 35, can be varied, according to requirements. As will be appreciated, the brake 31 is in the form of a pad which, by virtue of exerting yielding pressure on the top of the travelling strip 3, exercises frictional control over the latter.

The practical form of fin-rolling machine now being described is equipped with a guillotine indicated generally by the reference numeral 38 in Figure 9. This guillotine, which is stationed on the side of the rollers 1 and 2 remote from the edge folder comprises a fixed vertical blade 39, and a relatively movable vertical blade 40 which is slidable up and down between rebated vertical guides 41. The blades 39 and 40 are mounted upon a rectangular part 42 of the machine framework extending in front of the rollers 1 and 2. The slidable blade 40 is slotted to receive the ends of a pair of short arms 43 rigidly secured upon a transverse spindle 44 which

is arranged to turn in bearings in lugs 45 on the framework 42. One end of the spindle 44 projects through the appropriate lug 45 and has rigidly secured thereto a short link 46 pivotally connected with the forward end of a guillotine-actuating bar 47 arranged alongside the framework 42. The said actuating bar is influenced by a tension spring 48 one end of which is anchored to the top edge of the bar whilst its opposite end is engaged with a pin on the framework 42. The guillotine is cam-actuated through a train of variable speed gears permitting the frequency of the guillotine strokes to be varied according to the length of fin required. Thus, as will be seen in Figures 9 and 10, the rear end of the bar 47 is furnished with a laterally extending pin 49 arranged in contact with the periphery of a rotary edge cam 50. This cam is associated and adapted to rotate together, with a spur gear 51 arranged in mesh with an idler gear 52 which is driven by a further gear 53 secured upon the appropriate end of the shaft 15 of the bottom roller 2. The number of teeth on the gear 53 corresponds with the number of punch-like teeth 4 on any one of the separate discs 1¹ of the top roller 1. The edge cam 50 is formed with a lobe 50a adapted for action upon the pin 49, and the construction is accordingly such that each time the said cam is turned through one revolution, the actuating bar 47 is drawn back against the action of the tension spring 48 as a consequence of which the spindle 44 is turned to impart an upward and operative stroke to the movable guillotine blade 40 to cut off a fin from the rolled strip 3. The cam 50 and the associated gear 51 are mounted to rotate about a stub axle fixed in the side of the framework 42, and the bar 47 is slotted at 47a to enable this axle to extend therethrough without interfering with the movements of the bar. As will be appreciated, by changing the gear 51 for another of a different diameter the frequency of the guillotine strokes can be varied according to the length of fin required—this length determining the width of the radiator core structure to be built up from the fins. Whenever the gear 51 is changed, however, it is necessary to effect a compensating adjustment of the position of the idler gear 52, and to enable this to be done the spindle of the idler gear is mounted in a slotted carrier bracket 54 which is adjustable on a screwed pin or bolt 55 and is adapted to be clamped in position after an adjustment by means of a nut 56 and washer 57.

Alternatively, the guillotine may be electrically operated via a solenoid adapted to be controlled by a switching device from the aforesaid rollers.

Now as the hemmed and rolled strip issues from between the rollers 1 and 2 it tends to remain on the teeth 4 and, unless stripped from the same, would wrap around the upper roller. To prevent this there are provided, above the location where the strip issues from the rollers, a series of gravity controlled stripping fingers 58 (Figure 9) arranged for contact with the upper surface of the rolled strip. The presence of these fingers ensures that the strip is disengaged from the teeth 4 and so enables the strip to pass straight through the space 59 normally

provided between the cutting edges of the blades 39 and 40 of the guillotine. The inner ends of the stripping fingers 58 are pivoted upon a transverse spindle 60 fixed in brackets 61 carried by the framework 42.

The strip metal 3 may be continuously drawn from a coil of the material, in which instance the improved machine may incorporate a coil holder combined, if necessary or desirable, with a tensioner.

The simple fin-producing machine of this invention may advantageously include a sheet metal cabinet or any other appropriate form of base structure the top of which may constitute a table for the support of the strip metal after passage thereof through the rollers. The edge folder, the top, i. e. male, roller 1 and the guillotine would be mounted on the top of such a cabinet or structure whilst within the latter would be accommodated the coil holder, the bottom roller 2 and the speed reduction gearing through the medium of which the latter is driven.

I claim:

1. A machine for producing fins for finned tube core structures, comprising a pair of co-operable rollers acting on and feeding forward an initially flat strip of thin and easily deformable metal introduced between them, one of the rollers being formed with appropriately disposed and shaped teeth constituting punches while the other roller has formed therein correspondingly disposed and complementarily shaped recesses, each punch-like tooth being so bevelled at its two sides as to define a straight cutting edge, the bevelled surface at one side being more steeply inclined than the bevelled surface at the opposite side, with the line of intersection of the two bevelled surfaces being offset with respect to a radial plane extending through the axis of the toothed roller and the median line of the root of the tooth, the said punches and recesses piercing and deforming the fed strip as to produce therein peripherally flanged openings, and means for driving the rollers.

2. A machine for producing fins for finned tube core structures, according to claim 1, wherein one of the rollers is of a fixed length commensurate with a fin of maximum width while the other roller is made up of a plurality of co-axial disc-like sections the number of which is variable to correspond with the width of the fin required, said sections mounted along a shaft, two thin concentric rings mounted on said shaft between said shaft and each of said sections, and an elastic bushing interposed between said two rings.

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