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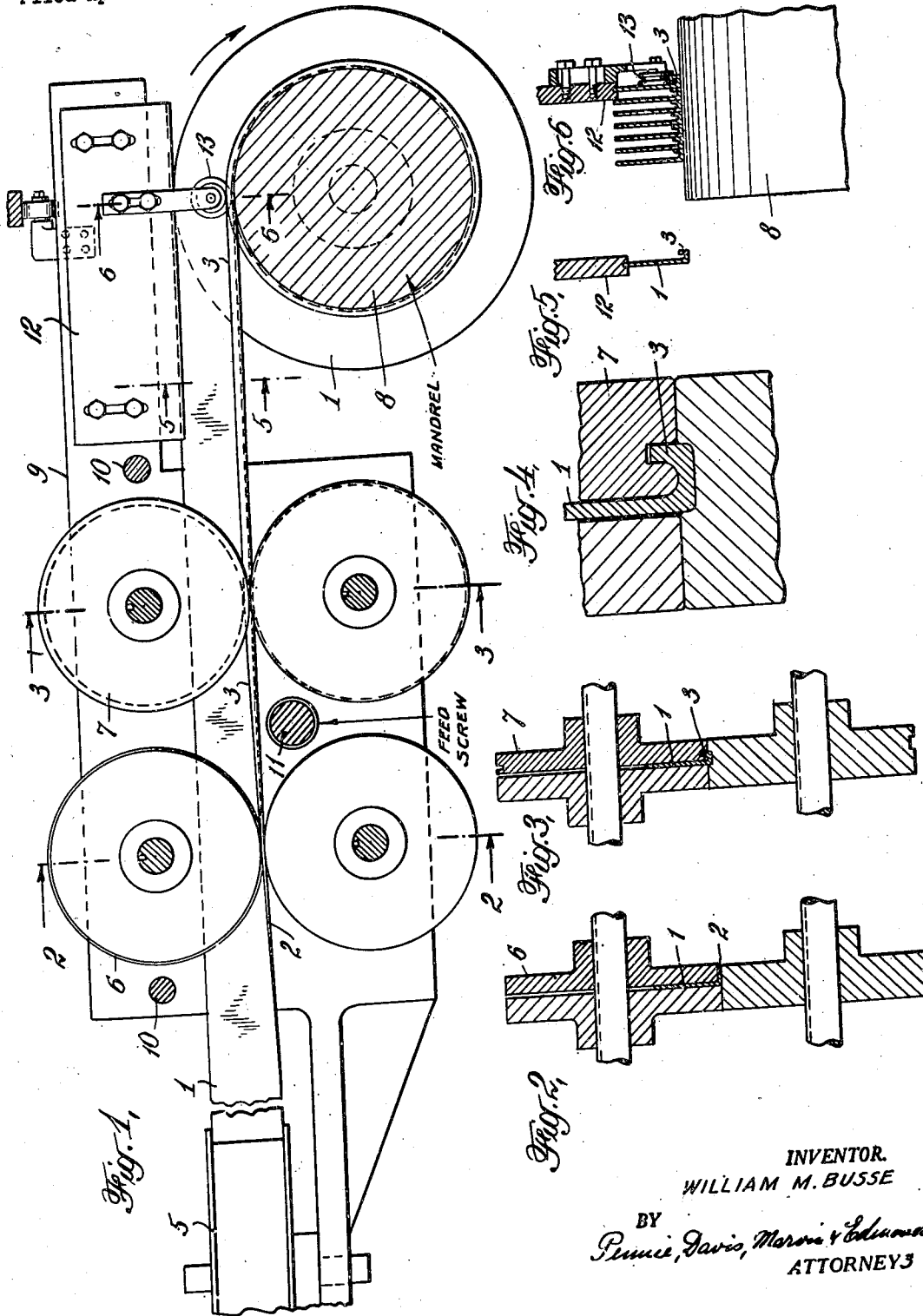
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2,472,245

METHOD OF FINNING ENGINE CYLINDERS

2 Sheets-Sheet 1

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2 Sheets-Sheet 2

Fig. 8.

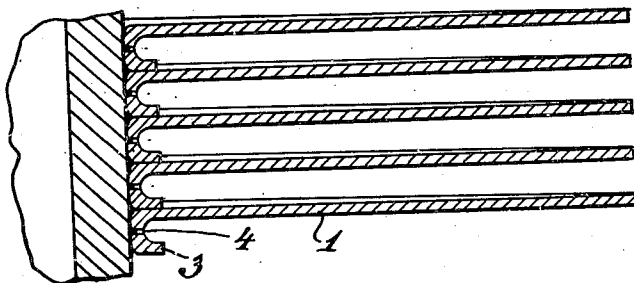
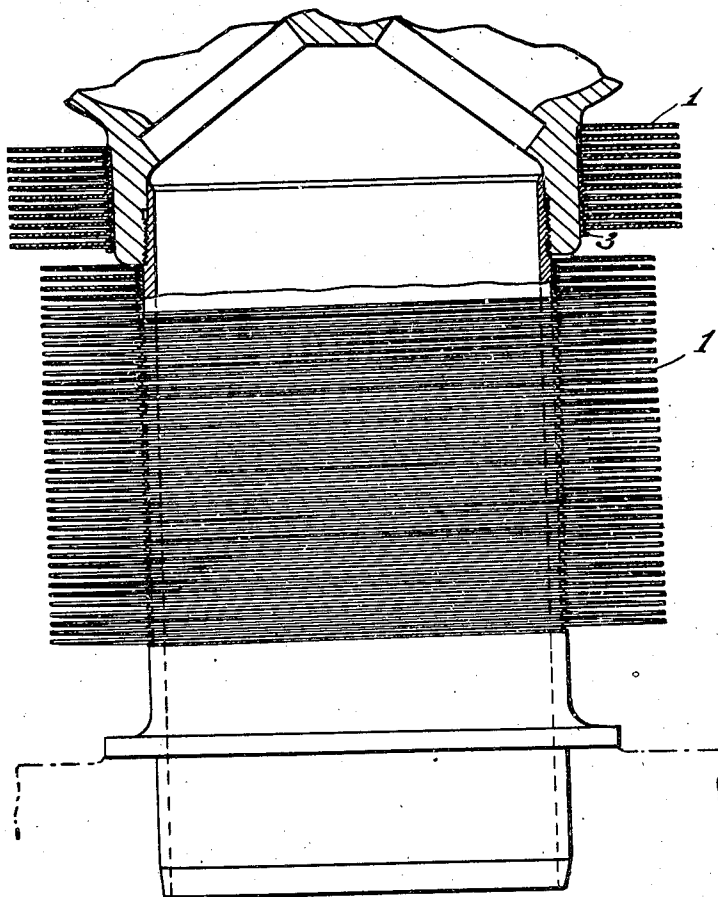


Fig. 7.



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2,472,245

METHOD OF FINNING ENGINE CYLINDERS

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1 Claim. (Cl. 29—157.3)

1

This invention relates to methods for making engine cylinders, particularly cylinders for high-compression, air-cooled aviation engines, and has for its object to provide a method for making cylinders having a highly extended heat-radiating surface whereby danger of failure of the engine from overheating is greatly reduced. It is well known that the power output of aviation engines per cubic inch of cylinder capacity has been greatly increased by recent developments in engine structure to obtain high compression, and also by the development of new fuels. This increase in the power produced per unit of cylinder capacity must be accompanied by an increase in heat-radiating capacity to prevent failure of the engine from overheating.

It has heretofore been the general practice to form by casting or machining, heat-radiating fins directly on and integral with the cylinder wall or with a sleeve which is shrunk or otherwise attached to the cylinder. Such process, however, has limitations in the amount of extra radiating surface that can be provided, and cylinders so constructed cannot be safely employed and obtain the power output which is obtainable in liquid-cooled engines of equal cylinder capacity.

The principal object of the present invention is to provide a method for producing an engine cylinder having a greatly extended heat-radiating surface, rapidly and efficiently on a mass production scale.

A further object of the invention is to provide an apparatus for use in carrying out my improved method which is of simple design, easily constructed, and foolproof in operation even in the hands of relatively unskilled workmen.

Briefly stated, my improved method consists in forming from a flat metal ribbon a helically finned sleeve of a diameter to fit the cylinder and thereafter soldering or otherwise attaching the sleeve to the cylinder wall. The ribbon, preferably of coppered aluminum, is drawn through forming dies or rollers to form on one edge of the ribbon an L-shaped foot with a short flange parallel with the main portion of the ribbon. The ribbon so shaped is tightly coiled to produce, in effect, a substantially rigid tube from which short sleeve sections are cut and soldered to the wall of the engine cylinder in the same manner that cast sleeves having integral fins are now employed when it is desirable to provide a heat-radiating surface of different metal from the cylinder itself.

In the accompanying drawings,

2

Figure 1 is a side view partly in section of a machine for carrying out my improved method;

Figs. 2 and 3 are sections on lines 2—2 and 3—3, respectively, of Fig. 1;

Fig. 4 is an enlarged sectional view of a portion of Fig. 3;

Figs 5 and 6 are sectional views on lines 5—5 and 6—6 of Fig. 1;

Fig. 7 is a side elevation partly in section of a cylinder manufactured in accordance with my improved method; and

Fig. 8 is a detail section on an enlarged scale of a portion of the cylinder shown in Fig. 7.

In Fig. 1 I have illustrated an apparatus for shaping the ribbon and coiling it into a continuous sleeve or tube. As shown, the ribbon 1 is supplied from a spool 5 set on a vertical axis from which it passes between successive pairs of forming rolls. As here shown, two pairs of rolls 6 and 7, respectively, are employed, but additional pairs of rolls may obviously be used if necessary or desirable in the shaping of the ribbon. The thickness and stiffness of the metal employed for the fin determines the number of rolls necessary or desirable to bend the edge of the ribbon to the desired shape. As shown, the rolls 6 bend one edge 2 of the ribbon to a right angle with the main width of the ribbon, while the second pair of rolls 7 form a narrow flange 3 on the edge of the right angle portion 2 to thereby form a spacer flange having a flat radial contacting surface for engagement with the radial face of the adjacent portion of the ribbon. The rolls 6 and 7 are preferably supported so as to be rotated by the ribbon as the ribbon is drawn through the rolls. The rolls 6 and 7 may of course be driven if desired, but in the preferred method of carrying out my invention the rolls are not driven but serve to apply to the ribbon sufficient drag to insure a tight winding of the ribbon on the mandrel 8.

The supply reel 5 and rollers 6 and 7 are preferably supported on a longitudinally movable carriage 9, supported, for example, on guide rods 10 extending parallel with the mandrel. The carriage is shifted by a feed screw 11.

The mandrel 8 is continuously rotated through a suitable gear mechanism, not shown, and the relation of the rotary motion and the axial motion of the carriage is such that the mandrel, during each rotation, is shifted the exact width of the L-shaped foot of the ribbon.

To insure an even winding of the ribbon on the mandrel I preferably provide adjacent the man-

drel a fixed backing block 12 which extends from a point adjacent the top of the mandrel to a point near the last pair of shaping rolls 7. Also adjacent the mandrel is a guide roller 13 having a convex periphery shaped to fit the space between the up-turned margin 3 and the adjacent face of the fin. The backing block 12 serves to hold the ribbon in its direct path of movement from the forming rollers to the mandrel and prevents any outward buckling of the ribbon due to the resistance of the coiling operation. The backing block preferably has a groove in its under surface for receiving the upper edge of the fin. In some instances it may be advantageous to have the groove in the backing block deep enough to receive a substantial width of fin. Also the backing block with a groove embracing a substantial portion of the fin may be extended partly around the mandrel to guide and support the fin during the initial winding operation.

In operation the end of the ribbon is initially shaped by hand throughout a length sufficient to reach from the rolls to the mandrel, a portion of the ribbon being of intermediate shape to conform with the peripheries of the rolls 6. The ribbon is then threaded through the rolls and attached to the mandrel which is rotated while the carriage 9 is advanced axially as described, thereby winding the ribbon on the mandrel to form a continuous tubing the length of which is limited only to the length that it is expedient for the mandrel.

After the tube or sleeve is finished it may be cut into sections of proper length for the cylinders to which it is to be attached, and these sections are then fitted over the cylinder and attached to the cylinder in the usual manner, for example, by soldering. The sleeve of the helically wound fin is particularly suitable for soldering for the reason that the meeting edges of the fin proper and the out-turned flange 3 of the L-shaped foot form on the inside of the sleeve a continuous shallow groove into which the melted solder expands, thereby forming a tight joint. If desired to increase the interlocking between the solder and the fin the L-shaped foot 3 may be perforated at intervals in the portion of the foot parallel with the cylinder wall, as indicated at 4.

Any approved method of soldering the sleeve to the cylinder may be employed. For example, the outer surface of the cylinder may be provided with an external covering of solder before the sleeve is applied, or the molten solder may be forced by pressure between the outer surface of the cylinder wall and the inner surface of the sleeve. In this case the mandrel used for forming the sleeve will be sufficiently larger than the cylinder to provide a space of the desired width to receive the solder.

Before cutting the sleeves for the individual cylinders from the length of tubing, it may be desirable to fasten, as by spot welding, the outwardly-turned flange 3 of the L-shaped foot to the adjacent face of the fin with which the flange is in contact. Two such spot welds are made, one on each side of the point where the sleeve for the engine cylinder is to be cut off from the length of tubing.

Instead of soldering the sleeve sections to the engine cylinders they may be shrunk onto the cylinders or welded. High melting point solder, however, forms a joint of ample strength and also of high heat-conductivity, and is entirely satisfactory, particularly with a fin formed of coppered aluminum, as described.

Instead of winding the formed ribbon directly from a straight length onto the mandrel I may, if desired, particularly if the fin material is hard and not easily bent, employ a fin-coiling machine intermediate the forming rolls 7 and the mandrel, to thereby pre-coil the fin into a spiral and thereafter wind the spiral tightly on the mandrel. Such pre-coiling machine is shown in U. S. Patent No. 1,878,233 for pre-coiling a flat ribbon into a fin for subsequent application to a pipe or tube as a heat radiating element. Such a machine may with appropriate modification be employed to pre-coil a shaped ribbon, and as a modification of the present process I may, if desired, pre-coil the L-shaped fin and then apply the pre-coiled fin to the mandrel to thereby form a sleeve from which sections for application to the cylinder wall may be cut in the manner described.

In the drawing I have illustrated the mandrel as a solid shaft of the desired diameter, but if desired to facilitate the withdrawal of the mandrel from the sleeve or tube formed by the coiling of the ribbon, a collapsible mandrel of improved design may be employed. For example, the mandrel may be made of three sections with the middle section slightly tapered so that the relative axial movement of the middle section to the two outer sections will collapse the mandrel sufficiently to release the sleeve.

In carrying out the manufacturing operations on a commercial scale it is expedient to manufacture the finned sleeves in convenient lengths for handling and shipment, for example, ten or twelve feet. The labor cost of manufacturing these sleeves is quite moderate. The winding machines can be operated at about the same speed as the ordinary fin-winding machine and require practically no attention other than the removal of the finished sleeve, the return of the carriage to its initial position and the re-attachment of the cut off end of the ribbon to the mandrel.

The sleeve lengths can then be sent to the engine factory where they are cut in sections as needed and soldered or otherwise attached to the engine cylinders. The finned sleeve may be attached not only to the cylinder proper but also to the cylinder portion of the cylinder head, as shown in Fig. 7. Also, of course, the sleeve sections may be applied to other apparatus than engine cylinders wherever it is desired to add heat transfer surface to a unit having a cylindrical wall.

It will also be understood that the finned sleeves may be made in lengths greater than the length of the mandrel by the simple expedient of collapsing the mandrel when the carriage reaches a point near its end and returning the carriage to the other end of the mandrel and forming a second section of sleeve without cutting off the ribbon.

It will be further understood that the method may be otherwise modified within the scope of the appended claim.

I claim:

In the method of forming cylinders for engines and the like, the steps which comprise helically winding a strip of metal of L-shaped configuration to form a continuous sleeve of indefinite length with the foot portions of the L in contact and the upright portions forming a helical fin, fastening the foot portions of the L to contacting portions of the helical fin at spaced points, thereafter cutting the sleeve outwardly of and adjacent the points of said fastening to form a section for attachment to an engine cylinder, and

2,472,245

5

fastening said section as a unit to the exterior
of an engine cylinder.

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REFERENCES CITED

The following references are of record in the
file of this patent:

UNITED STATES PATENTS

Number	Name	Date
855,239	Faries	May 28, 1907

Number
1,032,925
1,498,891
1,623,766
1,628,804
1,668,534
1,878,233
1,896,350
2,327,259
2,372,795

6

Name	Date
Miller	July 16, 1912
Steenstrup	June 24, 1924
Way	Apr. 5, 1927
Price	May 17, 1927
Berg	May 1, 1928
Dewald	Sept. 20, 1932
Bundy	Feb. 7, 1933
Gay	Aug. 7, 1943
Rodeck	Apr. 3, 1945