

May 1, 1923.

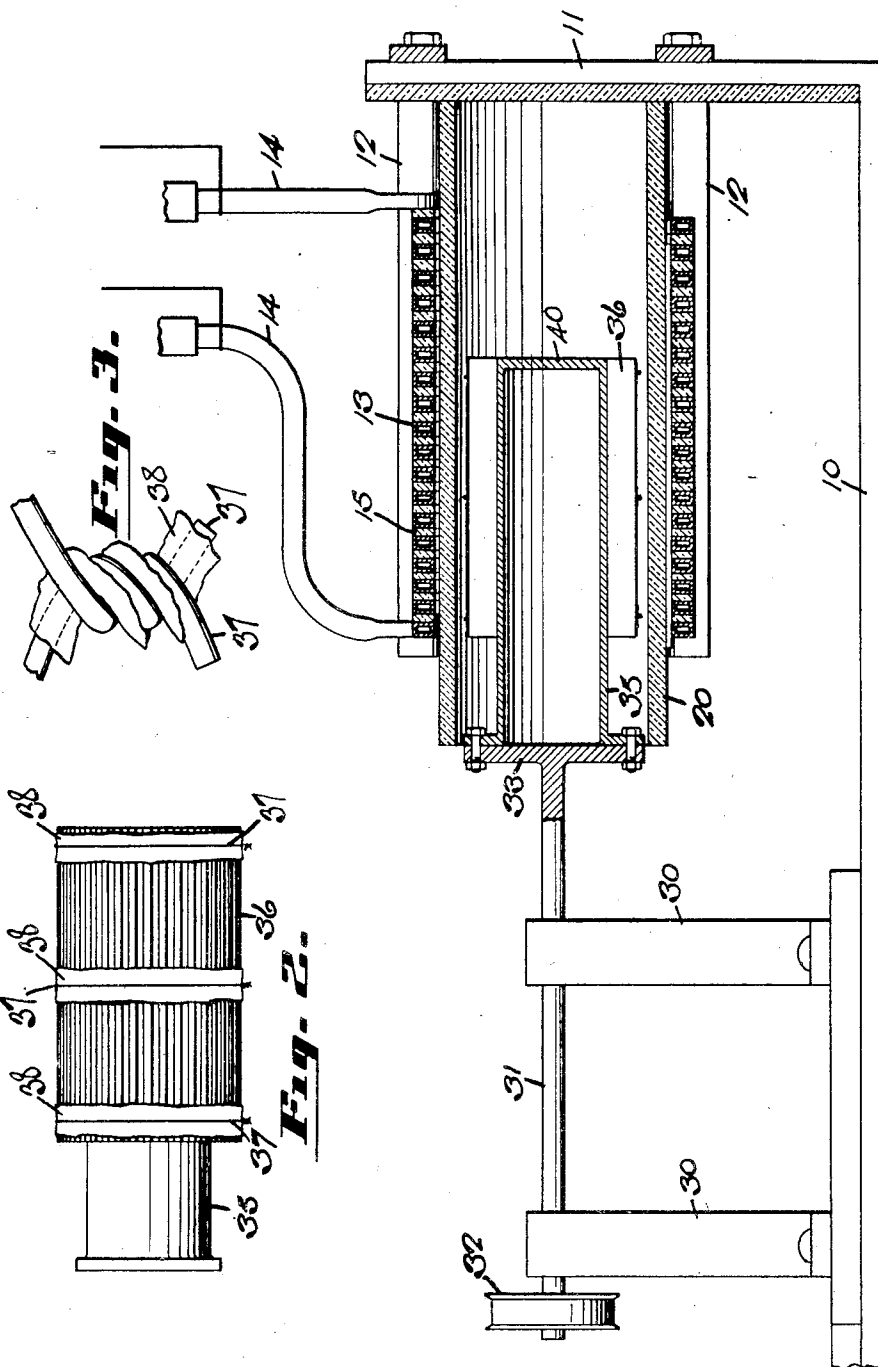
1,453,358

C. F. KETTERING

PROCESS OF JOINING METALS

Filed Dec. 15, 1920

2 Sheets-Sheet 1



Witnesses
L. H. Emrick
A. C. Lehman

By

Inventor
Charles F. Kettering.
Kerr, Page, Cooper & Hayward.
Attorney

May 1, 1923.

1,453,358

C. F. KETTERING

PROCESS OF JOINING METALS

Filed Dec. 15, 1920

2 Sheets-Sheet 2

Fig. 4.

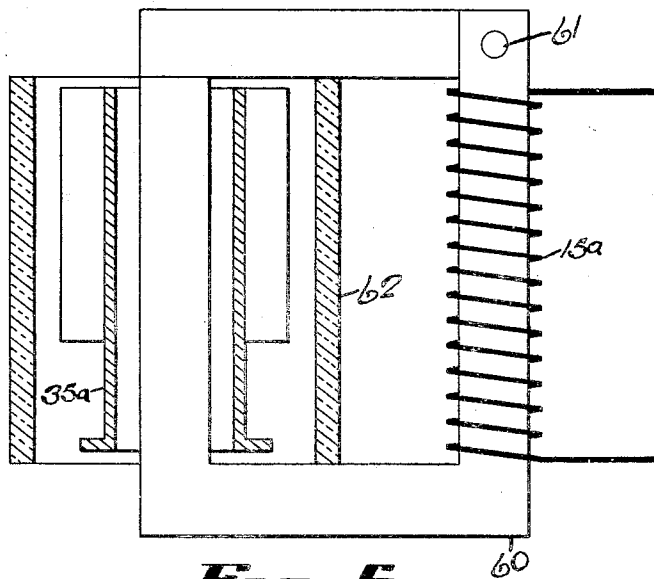
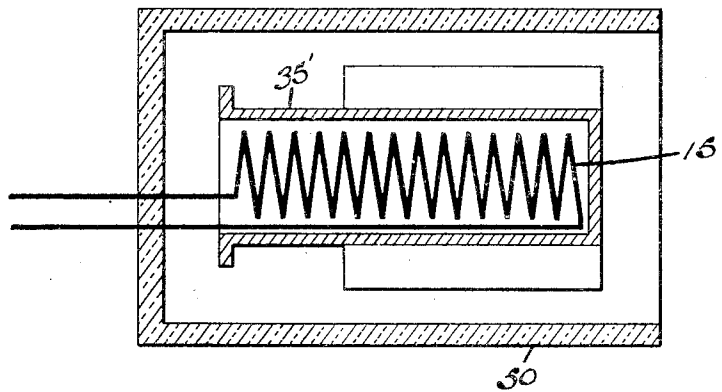


Fig. 5.

Witnesses
L. H. Emrick
A. C. Lehman

By Charles F. Kettering.
Kerr, Page, Cooper and Hayward.
Attorney

UNITED STATES PATENT OFFICE.

CHARLES F. KETTERING, OF DAYTON, OHIO, ASSIGNOR TO GENERAL MOTORS RESEARCH CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

PROCESS OF JOINING METALS.

Application filed December 15, 1920. Serial No. 430,841.

To all whom it may concern:

Be it known that I, CHARLES F. KETTERING, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Processes of Joining Metals, of which the following is a full, clear, and exact description.

The present process relates to the joining of metals and in its preferred form, which has been chosen for the purpose of description and illustration, relates more particularly to the attachment of non-ferrous metal cooling elements (such as copper fins) to ferrous metal cylinders for internal-combustion engines.

Among the objects of the invention is the shortening of the time consumed in such operations and the conducting of such operations under more easily and exactly controlled conditions.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 represents more or less diagrammatically a form of furnace for carrying out the present process, parts being in longitudinal section.

Fig. 2 is an elevation of an assembly of an engine cylinder and fins ready to be placed in the furnace.

Fig. 3 is a detail of the assembly shown in Fig. 2 but on a greatly enlarged scale.

Figs. 4 and 5 are diagrammatic representations of modified forms of furnaces suitable for use in the present process.

In Fig. 1 the furnace proper consists of a frame 10 having an upright portion 11 to which is attached by means of suitable clamps 12 a water cooled copper coil 13, having leads 14 for both water and electrical energy. The coil is suitably insulated and lagged as indicated at 15.

Within the coil 13 there is a quartz tube indicated at 20 for the purpose of electrically insulating materials within the furnace and also for protecting the coil to some extent against radiated heat.

Mounted upon the opposite end of the frame 10 from the upright 11 are suitable posts 30 provided with bearings in their upper ends for shaft 31. This shaft 31 carries, at the end opposite the furnace, means for rotation, represented by a pulley 32. At its other end, nearest the furnace, the shaft is provided with means for attaching the work piece. In the present illustration, the work piece is represented as being an internal-combustion engine cylinder 35 assembled with fins 36 as illustrated in Fig. 2. This cylinder is bolted to a plate 33 attached to the end of shaft 31.

It will be noted that this supporting and rotating shaft 31 should be so mounted as to permit the insertion and removal of the work piece into and from the furnace tube 20.

The cylinder assembly represented in Fig. 2 consists of the cylinder proper 35, and the cooling elements 36 which latter are placed around the cylinder with an interposed sheet of brazing brass and suitable fluxes as described in my application, Serial No. 514,014, filed November 9, 1921, upon the process of which the present case may be considered an improvement.

In the former application, the rotation of the assembly while heating is mentioned as one method of maintaining the distribution of the brazing metal and this or an equivalent step is quite important in such operations as attaching copper fins to cylinders in the manner shown, and it is for this same purpose that the present construction is chosen.

The present assembly differs from the assembly described in the previous application, however, in that the wires 37, used to hold the assembly together while heating, are insulated from the cooling elements against the passage of both heat and electric current. This may be accomplished in several ways and I have indicated on the drawing, the use of a thin strip of insulating material, preferably asbestos, indicated at 38. Further, these wires 37 should be so arranged as to break the circuit formed by twisting the ends and one way of doing this is to twist a piece of insulating material between the ends of the wires as indicated in Fig. 3. Other materials may be used to

accomplish this same result and other materials can undoubtedly be used in the place of asbestos.

The operation of the apparatus just described is as follows.

The assembly of cooling elements and cylinder is first bolted or otherwise secured to the supporting and rotating shaft 31 and is then inserted into the tube 20 of the furnace, care being taken to position the cylinder at such location in the furnace that the head 40 of the cylinder is located at a point within the influence of the current in coil 15 that the heating of the head and the walls of the cylinder will be uniform. No exact information need be given as to the placing of the cylinder within the coil as its position will depend upon the dimensions of the cylinder, that is, upon the thickness of the walls and head and upon the length of the cylinder. However, this location can be readily and easily determined.

When the cylinder has been suitably prepared and positioned in the furnace, cooling water is allowed to flow through the coil and a current of high frequency is also allowed to flow therethrough. The result of this flow of current is that any conducting material inside of the coil has induced therein currents which will cause it to become heated, as is well known in the induction furnace art. The coil is formed of a small pipe and the water is allowed to flow therethrough solely for the purpose of keeping the metal of the coil at a sufficiently low temperature to prevent its being burnt through by the intense heat generated.

While the above form of furnace is considered at present, the preferable form of apparatus for carrying out the process, other forms of induction furnaces can be very readily used for the operation.

For example, in Fig. 4, there is shown a diagrammatic representation of a form of furnace more or less similar to that of Fig. 1, but in this case, the coil 15' is inserted within the cylinder 35' and the whole is enclosed within a suitable casing 50 for the purpose of heat and electrical insulation.

Still another form is represented diagrammatically in Fig. 5, and this type is the so-called transformer type.

In Fig. 5, the coil 15^a is at one side of a suitable core 60, and the cylinder which takes the place of the secondary winding, is positioned around another portion of the same core as indicated at 35^a.

In order that the cylinder may be placed in proper position over this other portion of the core, the latter may be provided with a suitable hinge as indicated at 61. In this form also, the cylinder is preferably enclosed in a suitable heat insulating casing 62 and may also be mounted for rotation as in the other forms.

While there has been described several forms of apparatus in which the present process may be carried out, it should be understood that the process is not limited to the forms shown but other apparatus may be devised and found more or less satisfactory, in fact it is contemplated that not only may the heat be generated in the metals themselves by induced currents, but it may also be generated in the metals as the result of resistance to the passage of currents caused to flow by electromotive forces external to the material to be heated which latter forms part of the circuit.

While the process in this case is analogous to the process described and claimed in the above mentioned prior application, Serial No. 514,014, it will readily appear that it has several advantages over the prior process, for example, the electric heating permits more uniform and accurate control of the heat. Further, particularly in the case of joining copper fins to iron or steel engine cylinders, the heating from resistance of induced currents properly arranged apparatus causes a much more rapid and higher heating of the iron or steel than of the copper, which is very desirable in this operation. Again, generating heat within the metal of a work piece itself, it will readily be seen that by only minor changes in the apparatus, the heating can be carried out in any kind of an atmosphere that may be found desirable or even in vacuum.

Further, while the process has been described and illustrated, as applied to attaching cooling elements to an internal-combustion engine cylinder, it should be understood that it is not limited to the production of such articles, but may be utilized in the preparation of many other and quite different articles. For example, it is contemplated that this process might be used in a great many brazing operations or in other operations wherein dissimilar metals are to be joined.

Also, while the specific process herein described and illustrated, constitutes a preferred form of embodiment of the present invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. The process of joining metals which comprises placing the metals in proper relative position together with suitable bonding materials and heating the assembly by generation of heat within the body of one or more of the metals.

2. The process of joining metals by brazing which comprises assembling the metals with brazing material and suitable fluxes and heating to the brazing temperature by generation of heat within one or more of the metals themselves.

3. The process of attaching metal cooling elements to cylinders for internal-combustion engines, which comprises assembling the cylinder, the cooling elements, and suitable
5 attaching medium and heating the assembly by generation of heat within one or more of the metals constituting the assembly.

4. A process of attaching non-ferrous cooling elements to ferrous metal cylinders
10 which comprises assembling the said elements and cylinders in proper relation with interposed attaching material and heating the assembly to the proper temperature by generation of heat within one or more of the
15 metals themselves.

5. A process of attaching non-ferrous cooling elements to ferrous metals cylinders which comprises assembling the said elements and cylinders in proper relation with
20 interposed attaching material and heating the assembly to the proper temperature by generation of heat within one or more of the metals themselves, while rotating the assembly.

25 6. The process of attaching proper cooling elements to internal-combustion engine cylinders which comprises assembling the said elements and cylinders in proper relative position with brazing material interposed
30 and, while rotating the assembly, heating the assembly to the brazing temperature by generation of heat within one or more of the metals themselves.

35 7. The process of attaching copper cooling fins to ferrous metal engine cylinders which comprises assembling the said fins and cylinders in proper relative position with braz-

ing metal interposed and, while rotating the assembly, heating to the brazing temperature
40 by generation of heat within one or more of the metals themselves.

8. The process of attaching copper cooling fins to ferrous metal engine cylinders which
45 comprises assembling the said fins and cylinders in proper relative position with brazing metal interposed and, while maintaining the distribution of the brazing material, heating to the brazing temperature by generation of heat within one, or more of the
50 metals themselves.

9. The process of joining metals which comprises placing the metals in proper relative position together with suitable bonding materials and heating one or more of the
55 metals by electric currents which are induced therein from an alternating magnetic field.

10. The process of attaching copper cooling fins to ferrous metal engine cylinders which comprises assembling the said fins and
60 cylinders in proper relative position with brazing material interposed and, while rotating the assembly, heating to the brazing temperature by heating one or more of the metals by electric currents which are in-
65 duced therein from an alternating magnetic field.

In testimony whereof I hereto affix my signature.

CHARLES F. KETTERING.

Witnesses:

LEE H. EMRICK,
ALVINA C. LEHMAN.