May 8, 1928. 1,669,005

P. HUSTADT ET AL

HEATING ELEMENT FOR TEMPERING MACHINES

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Fig. 1.

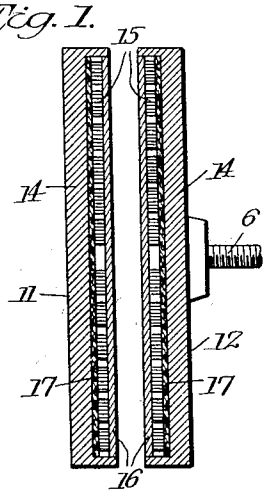


Fig. 2.

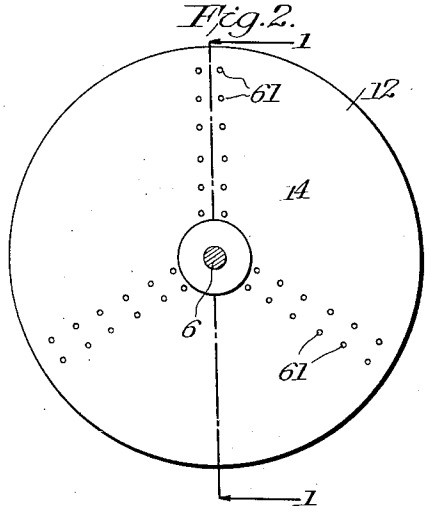


Fig. 3.

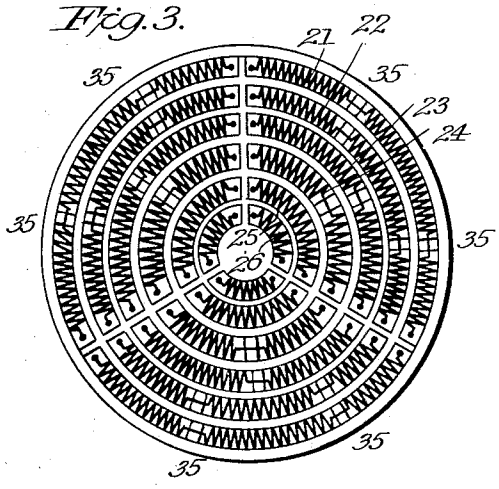


Fig. 4.

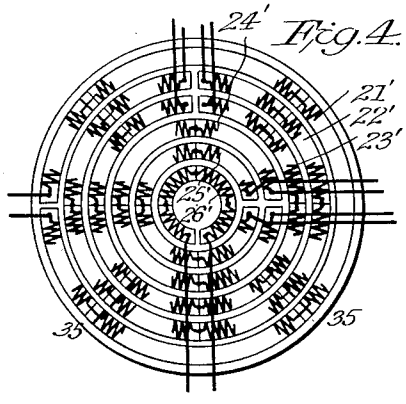


Fig. 6.

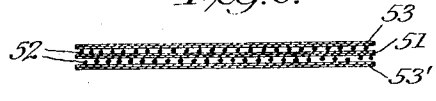
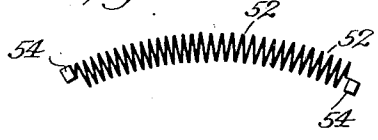


Fig. 5.



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Fig. 7.

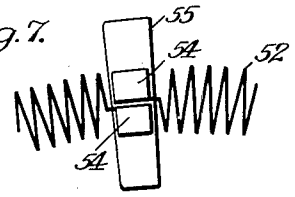


Fig. 8.

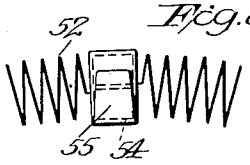


Fig. 9.

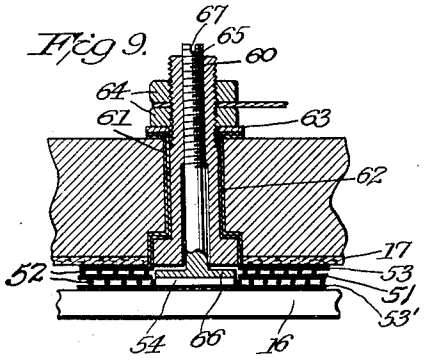


Fig. 10.

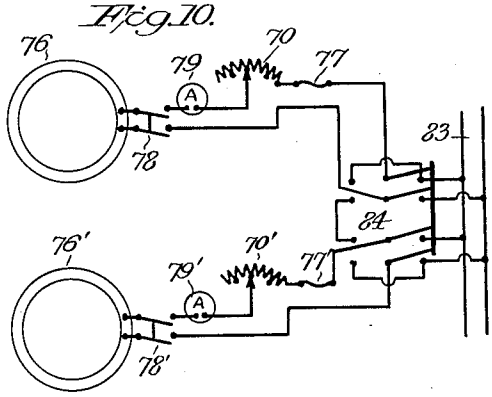


Fig. 11.

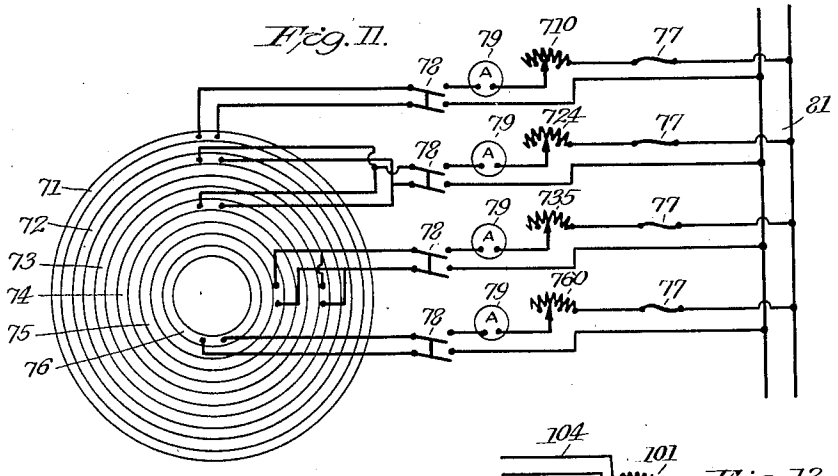


Fig. 12.

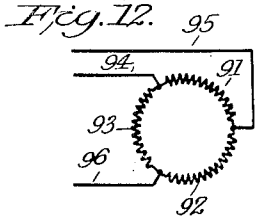
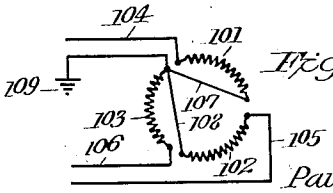


Fig. 13.



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UNITED STATES PATENT OFFICE.

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HEATING ELEMENT FOR TEMPERING MACHINES.

Application filed April 28, 1927. Serial No. 187,324.

This invention relates to a process of tempering and straightening saw blades, plane-knives, paper cutters and similar relatively thin tools by the simultaneous application of pressure and heat, and to the apparatus for performing this process.

This application is a continuation in part of our copending application Serial No. 650,694, for improvements in method and machine for tempering saw blades, plane-knives and similar tools, filed July 10, 1923.

This invention aims to provide for heating the saw uniformly and gradually to a suitable degree for obtaining the desired temper in the various portions of its area.

This invention further aims to improve upon the details of construction of saw tempering machines of the electrically heated type.

It will be understood that other advantages within the scope of the main aims, will be inherent in other forms of the invention suitable for various specialized purposes of the same general nature.

The objects and advantages of our invention will be apparent from the accompanying drawings and description, wherein we have shown, by way of illustration but not of limitation, certain preferred forms embodying the principles of our invention. For convenience we have illustrated the invention applied to a press of the type embodied in our British Patent No. 218,822 of July 17, 1924.

In the accompanying drawings, wherein the same reference characters are used for the same parts of all figures:

Fig. 1 is a cross-section, taken on line 1—1 in Fig. 2, of the opposed pressure and heating elements;

Fig. 2 is a partial plan view of the outer surface of the movable heating and pressure element;

Fig. 3 is a diagrammatic plan of an arrangement of heating elements suitable for three phase current;

Fig. 4 discloses an arrangement of the heating elements which is suitable for either direct current or single phase alternating current;

Fig. 5 is a plan view of a segment of a heating element with the outer insulation omitted;

Fig. 6 is a longitudinal section, in elevation, of the same, omitting the end connectors;

Fig. 7 shows a heating element joint in the first step of formation, and

Fig. 8 shows the same joint completed;

Fig. 9 is a cross-section of a portion of a press assembly plate, showing a binding post in longitudinal section;

Figs. 10, 11, 12 and 13 are diagrams of electrical circuits and connections;

In the form of our invention illustrated in our copending application, Serial No. 650,694, and in our British Patent No. 218,822, we employ two pressure plates adapted to clamp between them a saw blade, or other article to be tempered and straightened by the simultaneous application of gradually increasing pressure and uniformly controlled heat.

Referring to Fig. 1 of the drawings, the plate assembly 11 is intended to be relatively stationary, the plate assembly 12 being movable relatively thereto by the screw 6. These plate assemblies are capable of use in a frame of the general character shown in our British Patent and our copending United States application, both referred to above. Each assembly comprises a plate 14 of heavy construction, as, for example, cast iron, hereafter called the pressure plate, recessed on the front to receive electric heating elements shown generally at 15, faced over by a heating plate 16.

The inner surface of each pressure plate carries a layer 17 of asbestos or other suitable heat retarding material. Between this asbestos and the heating plate 16 the electric heating elements, generally indicated in Fig. 1 by the reference character 15, are arranged in concentric rings, as shown more particularly in Figs. 3 and 4, wherein each heating ring is indicated by its own reference character. The details of construction of these heating rings are such that they are capable of withstanding the working pressures employed, hence they can be used as compression members of the plate assembly. This gives the added advantage of avoiding any gap between the rings and the face plate 16, so that high thermal efficiency is obtained.

The concentric arrangement of our heating elements permits the distribution of heat to be controlled according to desired areas, particularly from the center outward. In practice the rings are usually from 40 to 50 mm. wide, with intervening spaces of about 10 mm. No grooves are provided for the

rings, the interior surfaces of plates 14 and 16 being flat. This arrangement is well adapted to segmental subdivision of the heating area, which may be advantageous in connection with the replacement of parts and the arrangement of the electrical circuits.

Figs. 3 and 4 show the concentric arrangement of the rings 21 to 26 and 21′ to 26′, inclusive, respectively. Each ring is divided into arcuate sections containing equal numbers of degrees, to permit easy replacement of damaged parts. The junctions of the several arcs are preferably on common radii. The rings in Fig. 3 are shown composed of arcs of 120° each for the reason that this figure is for a three-phase current. Each of these arcs may be mechanically subdivided into shorter sections in order to minimize the replacement necessary in case of damage. The junctions of such subdivisions are shown at 35. The rings in Fig. 4 are designed for single phase alternating current or for direct current. In this figure the subdivision of the three inner circles is 90° each, while that of the two outer is 45°, the construction being such as to permit employing arcs of a convenient length. Thus for a heating element of very small radius the separate portions might comprise as much as 180°, whereas for those of larger radius it might be advisable to make the separate elements only 22½° or perhaps less. It will of course ordinarily be preferable to have these subdivisions aliquot parts of a circle.

The details of construction of the heating elements are best seen in Figs. 5 and 6. Each element consists of a flat mica core 51 around which is wound a resistance wire 52 of cross section and length appropriate to the current and temperature. Wire of high specific resistance and high melting point, and capable of withstanding great pressure at high temperature, is necessary since the pressure is transmitted directly through the heating element. We have found chrome-nickel, Kruppen or Rheotan satisfactory. As shown in Fig. 6 the heating element is electrically insulated by mica strips 53 and 53′ on the exposed sides. Thermal insulation on the side towards the pressure plate 14 is provided, preferably by asbestos, as shown at 17, Fig. 1. We have found mica to be the most satisfactory substance for electric insulation since it possesses mechanical strength to withstand the necessary pressure at the temperatures reached, without electrical failure. Mica does not disintegrate below 600° C., while the maximum temperature employed in our process is about 425° C. for the usual grades of steel. In practice it has been found that heating elements so constructed are capable of withstanding a pressure of one hundred atmospheres.

The preferred method of joining the mechanical sections of the heating rings is seen in Figs. 5, 7 and 8. The resistance wire 52 is connected in any suitable manner at each end with a contact element 54, preferably of German silver. Each contact element occupies the opposite half of its respective end, so that sections of equal curvature are interchangeable. We have found that the most satisfactory junction is made by wrapping the opposed complementary ends with a metal strip 55 as illustrated by Figs. 7 and 8. When subjected to the heat and pressure of operation these strips form a secure contact which prevents arcing but which can be readily broken by unwrapping the strip.

In apparatus of this nature difficulty is frequently encountered in securing satisfactory binding post connections for the outer leads. We have obtained good results with the form of construction shown in Fig. 9.

The binding posts are hollow bolts 60 brought out through suitably located holes 61, Figs. 2 and 9, in the pressure plate 14, being insulated from the plate 14 by mica sleeves 62, Fig. 9, suitably flared, or provided with mica washers, at top and bottom, to conform respectively to a head on the inner end of the bolt and to a metal washer 63 below the usual connecting nuts 64 on the outer end. In order to maintain firm contact between the bolt and the metal end 54 of its associated heating element, the hollow center of the bolt is internally threaded to engage a stud 65, correspondingly threaded, having a flat head 66 on its inner end, Fig. 9. The outer end of this stud is provided with means to engage a turning tool, for example, a screw-driver slot 67, whereby the head 66 may be set up against the metal end 54 of its associated heating element. Thus, the internal contact may be tightened without disturbing the binding nuts 64.

Another important feature of our invention is the method of controlling temperature so that heat may be applied to the article uniformly and gradually, preferably from the center outward.

The detailed connections and arrangements of the electrical circuits for accomplishing this end will be varied according to the form of the article and the character of the current employed. We describe below typical arrangements which have been found satisfactory in practice with the currents and voltages most frequently met with, namely, three phase alternating current, single phase alternating current and direct current preferably at voltages of 110, 220 or 380. It will be understood that we present these circuits as illustrative, and not as limiting. Other suitable modifications which provide for accurate temperature control with the gradual application of heat as desired for the particular ar-

ticle are within the purview of our invention.

While it is desirable in tempering circular articles, such as the cutting disks described in our copending application Serial No. 133,724, that individual temperature control be provided for concentric zones from the center outward, it is not absolutely essential that each heating ring be on a separate circuit. We have found that satisfactory results are obtainable with simpler apparatus by having the innermost and outermost rings individually controlled, while the intermediate rings are connected in alternate pairs. Such an arrangement is seen in Fig. 11 where we have shown, by way of example, six heating rings 71 to 76 inclusive, rings 76 and 71 being each separately controlled, as by rheostats 710 and 760 respectively, while rings 72—74 and 73—75 are controlled in pairs as by rheostats 724 and 735, respectively. An ammeter 79, a fuse 77 and a cutout 78 will be provided for each circuit. A pair of main leads are shown at 81. It will be understood that Fig. 11 is merely diagrammatic of this aspect of our invention and the principles which it illustrates may be applied to arrangements having varying numbers of connection, for example, the three wire system of Figs. 3, 12 and 13 and the two wire system of Fig. 4.

Control of the heat may be obtained both by means of a rheostat in each of the heating circuits shown in Fig. 11, and by switching each circuit into either series or parallel connection with the corresponding circuit on the opposed heating plate, as shown diagrammatically in Fig. 10. In Fig. 10, 76 represents a single heating circuit in the plate assembly 11, Fig. 1, for example, the inner ring 76 of Fig. 11, while 76′ represents the corresponding circuit on the opposite plate assembly 12. The leads are shown at 83 connected with a suitable switch 84 to make either parallel or series connection. As in Fig. 11, each circuit in the upper plate 12 carries an ammeter 79, a fuse 77, a rheostat 70 and a cutout 78 and each circuit in the lower plate 11 is similarly equipped the corresponding elements being designated as 79′, 77′, 70′ and 78′, respectively. Where a pair of rings such as 72—74, Fig. 11, is controlled as a unit, this unitary pair may be connected in series or parallel, selectively, with the corresponding pair on the opposed plate. It will also be understood that Figs. 10 and 11 do not represent alternative circuits, but show different features which are to be used in conjunction in situations where the system of wiring permits it. In using a wiring system which is not adapted to series connection, of course no arrangements for series switching will be necessary.

Each heating ring will be connected in a manner appropriate to the type of current utilized, for example, a two wire system will require only a single pair of connections for each ring, as illustrated in Fig. 4.

In a three wire system either the delta or star connection may be used for the coils of each heating ring. Fig. 12 illustrates a delta arrangement of the resistance coils in a single heating circle, the individual coils of the circle being represented at 91, 92 and 93 and the conductors at 94, 95 and 96. Fig. 13 similarly illustrates a star connection. In this figure the coils of the circle are designated as 101, 102 and 103, and the conductors as 104, 105 and 106. Connections to the neutral points are shown at 107 and 108, this point being rounded at 109.

While we have illustrated and described herein arrangements of heating elements adapted for use in circular presses, it will be understood that the principles of our invention are equally applicable to presses of other forms such as may be necessary to give final temper and shape to noncircular articles.

For measurement of the current and temperatures, suitable instruments will be appriately placed in each circuit. The degree of accuracy necessary for satisfactory operation of the process may be attained with instruments of the types illustrated.

The article to be treated is clamped between plates 11 and 12, Fig. 1. Usually this article, for instance, a circular saw blade, will be warped as well as improperly tempered. At first sufficient pressure is applied by the screw 6 merely to hold the blade firmly. Current is now turned on all the heating rings of both plates. As the blade yields to the heat, the pressure is gradually increased, for flattening. The ammeter readings for all circuits are closely watched. When these readings indicate that the center has reached the desired temperature, the current in the inner rings, is reduced, or these rings cut out, as necessary. The intermediate and outer circuits are also regulated carefully to the end that the blank will be subjected to a uniformly graduated rate of heating preferably progressing from the center to the periphery. It is important that no part of the blank be at any time subjected to a greater heat than to which it is to be subjected at the conclusion of the treatment; and it is desirable that every portion of the blank should reach its proper final temperature at the same instant.

When this final temperature is reached, the treatment should be immediately discontinued; otherwise the blank may be injured. In stopping the treatment it is important that all portions of both sides of the blank be released simultaneously from the heat and pressure, to avoid uneven mo-

lecular structure. Such release may be effected by having the plates 11 and 12 in a substantially vertical position at the end of the process, whereby when the plate 12 is quickly backed away by the screw 6 the blank will fall away from both plates simultaneously.

It will be seen from the foregoing description that among the advantages of our invention are the provision of a mechanical and electrical arrangement of heating elements such that heat uniformly and accurately controlled may be applied to the blank under treatment, preferably gradually from the center outward; the provision of such heat control that selected portions of the blank may be subjected to such temperature conditions as circumstances render advisable, and the provision of heating elements whose mechanical construction will localize possible damage and permit the replacement of injured portions without disturbing others; said heating elements being of strength sufficient to withstand directly the compression stresses of the press members.

We claim:

1. In a tempering and straightening press, a plurality of compression-transmitting concentric electric heating elements, each of said elements being divided mechanically into a plurality of removable sections, and means engaging the adjacent ends of alining sections to secure them in electrical contact.

2. In a tempering and straightening press having a plurality of compression-transmitting concentric electric heating elements each comprising a wire-wound mica core and mica insulating plates on each outer side, means for independently securing said heating elements in said press, and means for electrically connecting the ends of said heating elements.

3. In a tempering and straightening press, a plurality of compression-transmitting concentric electric heating elements, each of said elements divided mechanically into a plurality of removable sections, said sections being joined by opposed complementary end contacts.

4. An electrical heating element resistant to crushing, comprising, in combination, an elongated narrow flat core of electrically non-conducting material capable of resistance to crushing strains while hot, a resistance winding thereon, elongated narrow flat strips against the external sides of said winding, said strips being constituted of material having characteristics similiar to said core, and electrical contact members of similiar shape, symmetrically but oppositely disposed on the opposite ends of said element.

5. In a tempering and straightening press, a plurality of compression-transmitting concentric electric heating elements, each of said elements divided mechanically into a plurality of removable sections, said sections being joined by opposed complementary end contacts wrapped about with a metal band.

6. In a tempering and straightening press, a plurality of compression-transmitting concentric electric heating elements in combination with a hollow internally threaded binding post having a movable stud through its center contacting the said heating elements.

7. In a tempering and straightening press, two opposed sets of electric heating elements, each of said sets comprising concentrically arranged members on circuits separate from the other members of said set, each of said circuits including the corresponding opposite members of each set.

8. In a tempering and straightening press, two opposed sets of electric heating elements, each of said sets comprising concentrically arranged members on circuits separate from the other members of said set, each of said circuits including the corresponding opposite members of each set, said circuits including means to connect said opposite members in parallel or in series as desired.

In testimony whereof, we have signed our names to this specification.

PAUL HUSTADT.
KARL HUSTADT.