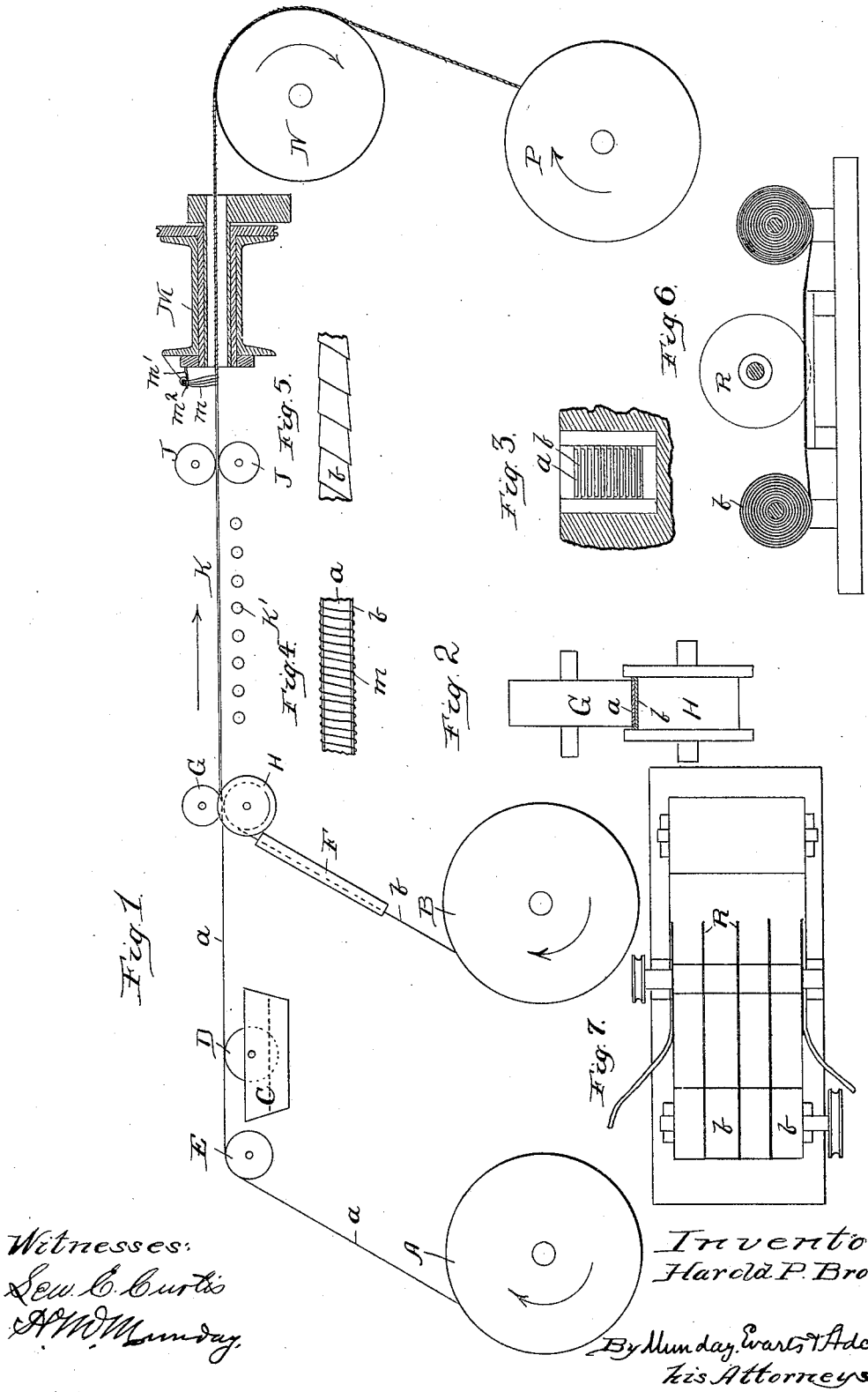
(No Model.)

H. P. BROWN.

ART OF MANUFACTURING ELECTROMAGNETS.

No. 546,220. Patented Sept. 10. 1895.



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UNITED STATES PATENT OFFICE.

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ART OF MANUFACTURING ELECTROMAGNETS.

SPECIFICATION forming part of Letters Patent No. 546,220, dated September 10, 1895.

Application filed January 26, 1893. Serial No. 459,823. (No model.)

To all whom it may concern:

Be it known that I, HAROLD P. BROWN, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in the Art of Manufacturing Electromagnets for Electric Machines, of which the following is a specification.

My invention relates to the manufacture of electromagnets for the armatures or field-magnets of electric machines, such as motors or dynamos, and more particularly to the manufacture of electromagnets having coils or windings composed of flat metal tape.

The object of my improvement is to provide a simple, practical, and efficient method or process of manufacturing electromagnets having coils composed of flat metal tape, whereby the same may be produced cheaply and rapidly and of such character that the magnet as a whole will present a firm, solid, and rigid mass, almost the same as if it were made of one piece, while at the same time the separate turns of the metal tape are efficiently and perfectly insulated from each other and the whole rendered both fireproof and waterproof.

To this end or object I, in practice, first cut asbestos paper into insulating-tape, slightly wider than the copper or metal tape to be insulated, by passing the asbestos paper under rapidly-revolving disks or saws running into grooves or slots cut into a metal plate, so that the edges of the tape may be cut smooth without being frayed and wind the asbestos tape on a spool into a roll. Ordinary paper-cutting machinery will not cut asbestos paper smoothly, as the fiber quickly dulls the knives and crowds between the blades, making torn and jagged edges. The metal disks running at a very high speed and having their lower edges entering grooves in a metal plate cut the asbestos quickly and smoothly. I then coat one or more surfaces, preferably the lower surface, of the copper or metal tape with shellac, preferably by leading it over a roller which revolves in a bath or vessel containing liquid shellac or other waterproofing liquid. I then impose the metal tape on the asbestos tape and fold or turn up the projecting edges of the wider asbestos tape about the edges of the narrower metal tape, and, preferably, by leading the asbestos and metal tape between a pair of revolving rollers, the lower one of which is grooved, so as to receive and turn up the edges of the asbestos tape about the edges of the metal tape. I then partially dry the shellac and press the two tapes firmly together, preferably by leading them through a space to give interval for drying in which heat may be applied, and between a pair of rollers to firmly compress the two tapes together. I then wrap the two tapes with an open spiral of binding-thread, preferably of cotton or asbestos, this being preferably done by passing the two tapes through a hollow revolving winding-spool. Leaving the spiral open permits inspection of the insulation during the process of winding. Where thicker insulation is desired, the spool containing the asbestos tape can be revolved around the copper tape, so as to form an overlapping spiral of the asbestos around the copper. I next wind the two tapes thus imposed upon each other, the one partially folded about the other and firmly compressed and bound together on a suitable spool, preferably a temporary spool, and adapted to contain at least a sufficient amount of tape for one complete coil of the magnet. I next wind the two tapes thus secured together one complete turn about the insulated core of the magnet, the winding being so done that the metal tape comes on top or on the outside, and then apply shellac to the upper surface of such turn, and so on, until the magnet-coil is completed, each turn of the coil being separately shellacked and each turn being separately hammered down firmly in its place or groove on the preceding turn at the outer face of the coil. Both surfaces of the asbestos tapes are thus coated with the shellac, one surface being coated when the metal and asbestos tapes are first brought together and the other surface being coated when the combined tape is wound in place in the permanent magnet-coil. The asbestos is thus saturated with shellac, thereby improving its insulating qualities and making it waterproof. I next compress the outer face of the magnet-coil thus formed and squeeze out the surplus shellac and hold the same compressed until the shellac becomes

partially dried or set, this being preferably done by applying a temporary compression-clamp. I then remove the temporary compression-clamp and apply the permanent holding bands, wires, or clamps by which the completed coils are held in place in the armature or magnet. The armature or other magnet being thus in this manner completed, I next heat its coil or coils gradually by the application of a current through the copper or metal tape to a sufficient degree to slowly evaporate the alcohol, water, moisture, or other liquid from the shellac and drive the same off slowly and gently without forming any incrustation on the outer surface of the coil, which would cause or tend to cause sponginess or perforations of such incrusted surface and injury to the insulation, and especially to its waterproof quality, property, or characteristic. I next, after the complete evaporation of the liquids in the shellac has been affected in the manner and by the slow and gentle heat described in the last step, heat the coil by increase of the current to a high degree, preferably about 250° centigrade or 435° Fahrenheit, to solidify and carbonize to a greater or less degree the shellac, and thus make the coil one rigid solid mass, the several turns or parts being firmly cemented together and to the spool or core and to the sides of the slot or groove thereof in which the coil is wound. An insulation is thus made between the turns of metal tape, which insulation is both fireproof and waterproof.

My invention consists in the combination of these several steps comprising the complete process, and also in the various subcombinations thereof.

In the accompanying drawings, to render the process more clearly and readily understood by those skilled in the art, I have illustrated a number of the several connected steps constituting the process, and also indicated tools or devices suitable for use in performing or carrying out the same.

In the drawings at Figure 1 is shown a spool of copper or metal tape A, a spool of asbestos tape B, the vessel C containing liquid shellac, a roller D revolving in the shellac and by which the lower surface of the copper tape *a* is coated with shellac, a guide-roller E, for the copper tape, a grooved guide-plate F, for the asbestos tape *b*, a pair of rollers G H between which the two tapes pass and by which they are brought together, the lower roller H being grooved so as to turn up the edges of the wider asbestos tape *b* about the edges of the narrower metal tape *a*, as is clearly indicated in the sectional view, Fig. 2. At K is shown the space through which the two combined tapes are led to give an interval for the shellac to partially dry, and thus cause the two tapes to adhere together, this space being preferably provided with steam-heating pipes or other heating devices K′. At J J is a pair of rollers which serve to firmly compress the two tapes together. M is a hollow winding-spool containing the cotton or asbestos thread *m*, and having a winding-finger *m′* and spreader m^2, by which the thread is wound in open spirals about the combined tape *a b*. N is a guide-pulley around which the combined tape passes to the temporary spool P, about which it is wound in suitable lengths to make the permanent magnet-coil.

It will be observed that in all the bends or turns which the combined tape *a b* makes, the asbestos tape *b* is on the inside and the metal tape *a* on the outside of the bend, so that the bending of the combined tape will not have any tendency to stretch, fracture, or perforate the insulating-tape *b*, but serve rather on the contrary to compress or close the same, and this feature or precaution is also observed in the final winding of the combined tape *a b* in the permanent coil of the magnet. The winding of the tape in lengths on the temporary spool P, may, if desired, be omitted, and the combined tape instead wound directly on the spool or core of the magnet-coil, but the preferable way is to wind it first on the temporary spool P, as the steps hereinbefore described may thus be carried on continuously.

At Fig. 3 I have shown a sectional view of the permanent magnet-core with the coil of the combined tape *a b* wound thereon.

At Fig. 4 I have shown a plan view of the insulated metal tape, and at Fig. 5 a plan view of the tape with the spiral insulation of asbestos. Any fireproof fabric may be used in place of the asbestos paper or any waterproofing compound in place of the shellac, the temperature of the final heating being regulated in accordance with the characteristics of the materials used.

At Figs. 6 and 7 is shown the asbestos paper-cutting disks R and the plate S, having grooves or slots *s* upon which the asbestos paper is supported while being cut into narrow strips or tape by the rapidly-revolving cutting-disks R.

I claim—

1. The improvement in the art of manufacturing electro-magnet coils of metal tape and insulating tape comprising the following successive steps: first, coating one surface of the metal tape with shellac; second, imposing the asbestos tape on the shellac-coated surface of the metal tape and winding or turning or folding the edges of the former about the latter; third, compressing the two together and partially drying the shellac; fourth, wrapping the two with binding thread in open spirals; fifth, spooling the combined insulating and metal tape; sixth, winding the combined tape in the permanent coil of the magnet and applying shellac to the upper surface of each turn and hammering or pressing the outer face of each turn snugly home or in place against the preceding turns; seventh, compressing the coil and squeezing out the surplus shellac and holding the same so compressed until the shellac becomes par-

tially dried or set; eighth, applying permanent holding devices; ninth, gradually heating the coil by application of current thereto to a sufficient degree to slowly evaporate the alcohol and moisture from the shellac and drive the same off without forming an incrustation of the shellac on the outer surface of the coil; and tenth, heating the coil by increase of current to a high degree to solidify and carbonize to a greater or less extent the shellac and thus make the coil one rigid solid mass and cement the same together and to the core or spool, and to make the insulation fire-proof and water-proof, substantially as specified.

2. The process of making electro-magnet coils of metal tape and insulating tape comprising the following steps:—first, coating one surface of the metal tape with shellac; second, imposing the asbestos tape on the shellac coated surface of the metal tape and turning or folding the edges of the former about the latter; third, wrapping the two with binding thread in open spirals; fourth, winding the combined tape in the permanent coil of the magnet and applying shellac to the outer surface of each turn; fifth, gradually heating the magnet coil thus formed by application of current thereto to a sufficient degree to slowly evaporate and drive off the alcohol and moisture from the shellac; and finally heating the coil by increase of current to a high temperature to solidify and carbonize the shellac, substantially as specified.

3. In the manufacture of electro-magnet coils composed of metal tape and insulating tape coated or impregnated with liquid shellac, the process consisting in first, gradually heating the coil by application of current thereto to a sufficient degree to slowly evaporate the alcohol and moisture from the shellac, and then heating the coil by increase of current to a high temperature to solidify and carbonize the shellac to a greater or less extent and cement the coils together in one rigid solid mass, substantially as specified.

4. The process herein described of gradually heating a magnet coil having an insulating material coated or impregnated with liquid shellac by application of current thereto to a sufficient degree to slowly evaporate the alcohol and moisture from the shellac without forming an incrustation of the shellac on the outer surface of the coil, and then heating the coil by increase of current to a high degree to solidify and carbonize the shellac to a greater or less extent and cement the coils together, substantially as specified.

5. In the manufacture of electro-magnet coils of metal tape and insulating tape, the process consisting in the combination of the following steps, first, coating one surface of the metal tape with shellac, second, imposing the asbestos tape on the shellac-coated surface of the metal tape and turning or folding the edges of the former about the latter; third, wrapping the two with binding thread in open spirals, and then winding the combined tape in the permanent coil of the magnet, and applying shellac to the outer surface of each turn, substantially as specified.

6. The improvement in the art of manufacturing electro-magnet coils of metal tape and insulating tape comprising the following successive steps: first, coating one surface of the metal tape with shellac; second, imposing the asbestos tape on the shellac coated surface of the metal tape and turning or folding the edges of the former about the latter; third, compressing the two together and partially drying the shellac; fourth, wrapping the two with binding thread; fifth, winding the combined tape in the permanent coil of the magnet and applying shellac to the surface of each turn and hammering or pressing the outer face of each turn snugly home or in place against the preceding turns; sixth, compressing the coil and squeezing out the surplus shellac and holding the same so compressed until the shellac becomes partially dried or set; seventh, gradually heating the coil by application of current thereto to a sufficient degree to slowly evaporate the alcohol and moisture from the shellac and drive the same off without forming an incrustation of the shellac on the outer surface of the coil; and finally heating the coil by increase of current to a high degree to solidify and carbonize to a greater or less extent the shellac and thus make the coil one rigid solid mass and cement the same together and to the core or spool, substantially as specified.

7. The process of making electro-magnet coils of metal tape and insulating tape comprising the following steps: first, coating the metal tape with shellac; second, imposing the asbestos tape on the shellac-coated surface of the metal tape and turning or folding the edges of the former about the latter; third, wrapping the two with binding thread in open spirals; fourth, winding the combined tape in the permanent coil of the magnet, and applying shellac to each turn; fifth, gradually heating the magnet coil thus formed, by application of current thereto to a sufficient degree to slowly evaporate and drive off the alcohol and moisture from the shellac; and finally heating the coil by increase of current to a high temperature to solidify and carbonize the shellac, in said steps or operations the asbestos insulating tape being maintained upon the inner side and the metal tape on the outer side in bending or winding the same to prevent any tendency of stretching or injuring the insulating tape, substantially as specified.

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Witnesses:
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