No. 806,574. PATENTED DEC. 5, 1905.

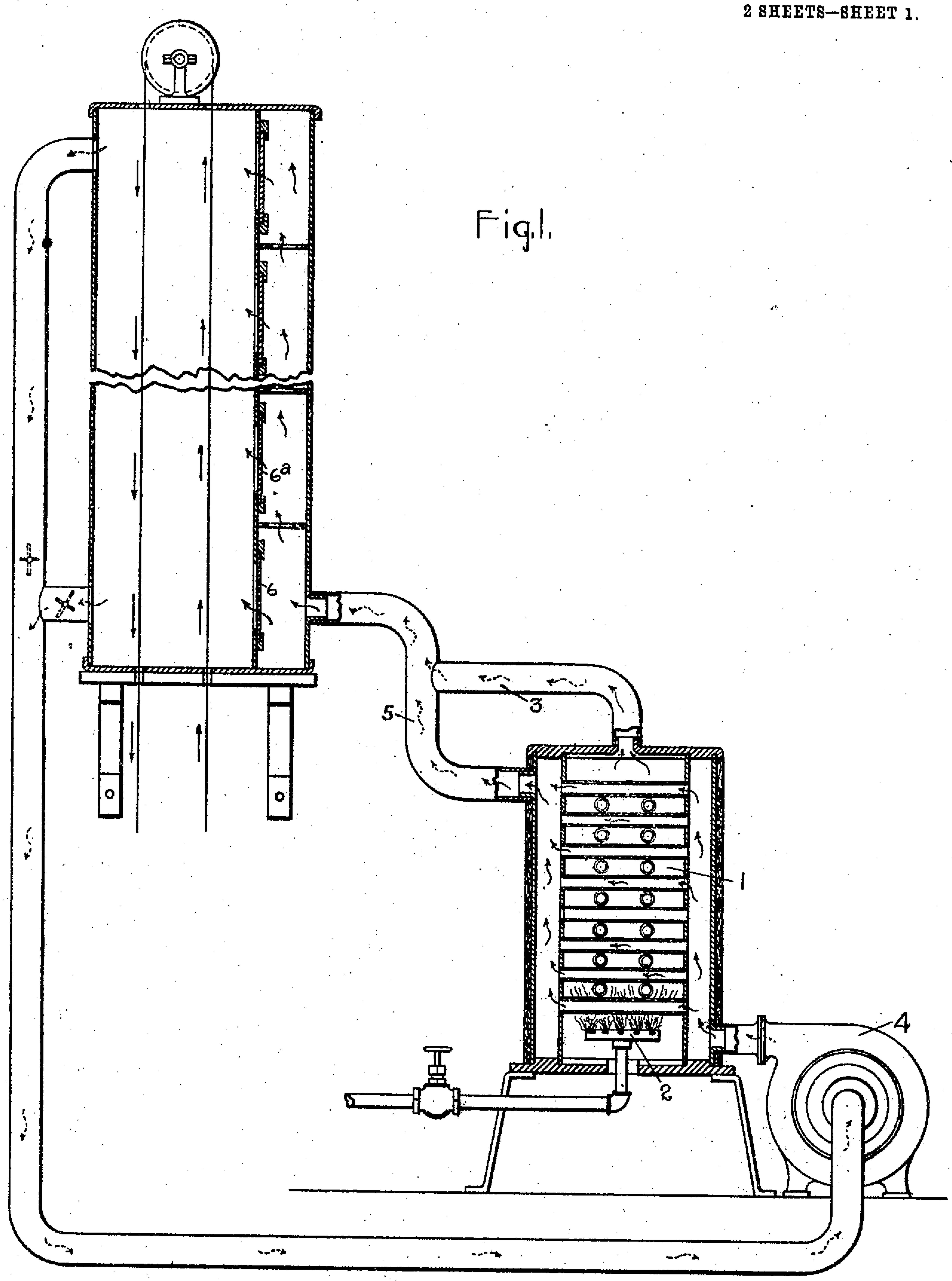
G. H. RUPLEY.

PROCESS OF MAKING INSULATED WIRES.

APPLICATION FILED DEC. 16, 1902.

2 SHEETS—SHEET 1.

Fig. 1.



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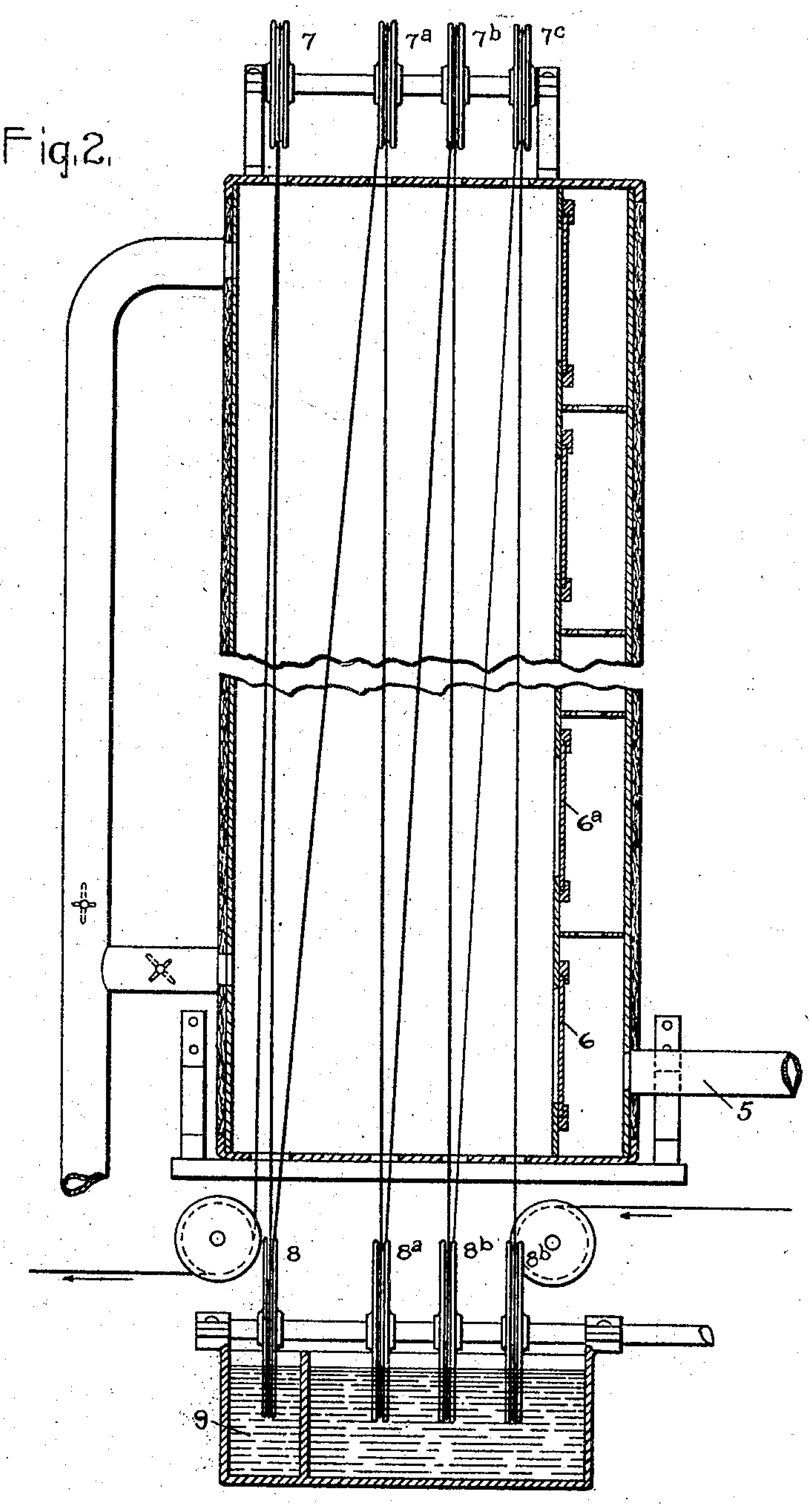
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

GEORGE H. RUPLEY, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

PROCESS OF MAKING INSULATED WIRES.

No. 806,574. Specification of Letters Patent. Patented Dec. 5, 1905.

Application filed December 16, 1902. Serial No. 135,372.

To all whom it may concern:

Be it known that I, George H. Rupley, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Processes of Making Insulated Wires, of which the following is a specification.

This invention relates to a process of making an insulated electric wire the insulating-covering of which may withstand a high degree of heat and may be satisfactory in insulation and cheap to manufacture.

Wires or conductors have heretofore been insulated by covering them with a winding or braiding of fiber—such as cotton, jute, or silk—alone or in combination with insulating gums or compounds. Cotton and silk wound wires require the employment of expensive machinery, and the process is a comparatively slow one, and they do not, moreover, withstand a high degree of heat, nor do they maintain the insulation if subjected to the influence of water or damp air. Conductors coated with fiber in combination with gums are not only not heat-resistant, but are usually very bulky and cannot be employed for light work. The conductors must be stout in order to carry the weight of the inclosing insulating compound, and the size of the conductor relatively to the conducting-core is so large that it can only be employed for line-work or in places where room is not a factor of importance. Wires have also been coated with collodion or other cellulose compounds with good results, but are expensive to manufacture and do not for the most part withstand as high a temperature as is desirable.

My present invention has for its object the manufacture of a conductor having an insulating skin or film which occupies a small amount of room, which is tough and flexible and will not crack under flexure of the conductor, which will withstand comparatively high temperatures—such, at least, as are commonly met with in the operation of electrical apparatus—which will have good insulating properties, and which will, finally, be cheap to manufacture.

My present invention is based upon the discovery that a hard and more or less tough and elastic residuum of good insulating property may be obtained from vegetable oils by distillation with or without the presence of oxygen, my process being distinguished from all other processes wherein vegetable oil is proposed as an insulation for electrical conductors by the fact that a supply of oxygen is not necessary.

The present application is limited as to its claims to the improved process, the article of manufacture resulting from the process being covered in a companion application, which is a division of this.

I carry out the invention by providing on the wire a smooth, dense, firmly-adherent, tough, flexible, glossy black coating of a residuum of an oil. I prefer to operate with a specially-treated linseed-oil, though my invention comprehends any oil which may be subjected to a process of distillation and will leave behind an insulating residuum. This includes all fixed and essential oils; but the one which I have found most satisfactory in practice is linseed-oil, though cotton-seed oil and even corn-oil may be and have been employed successfully.

In the accompanying drawings is shown an apparatus adapted to carry out my improvements.

Figure 1 is a diagrammatic view showing the heating arrangements, and Fig. 2 shows the relation of the bath to the heater.

In operating with linseed-oil I mix a suitable quantity, according to the bulk of product required, of raw linseed-oil with two per cent. of oxid of zinc and litharge each and subject them to protracted boiling. Materials of this kind have been heretofore added to oils; but the distinction of my process over those commonly employed consists in a more prolonged heating, producing not only saponification, but a partial distillation, which permits the subsequent hardening of the coated wire to be more easily and quickly effected, and the more complete the distillation of the lighter hydrocarbons or carbohydrates at this stage of the process the greater is the speed of hardening on the wire. I raise the mixed mass to a temperature of about 550° to 600° Fahrenheit, continuing the heat until the oxids are entirely taken up by the oil and the required degree of distillation has been effected. This causes a partial saponification of the oil, and the more completely this saponification is effected the greater the speed with which the coating of the wire may subsequently be effected. The glycerids are broken up and glycerin and other elements of the oil driven off. Care must be had, however, not to continue the operation too long, as an increase beyond a critical limit converts the mass into a semisolid, which cannot readily be dissolved. I have found an application of the heat for ten to fifteen hours to yield satisfactory results. This stage of my process is very important, as it when properly conducted gets rid by distillation of glycerin and other compounds, which prevent the film hardening, and in this way permits a rapid hardening after the wire is coated. After the oxids are completely combined with the oil the heat is allowed to drop to from 500° to 525° Fahrenheit, at which it is held, accompanied by constant stirring of the liquid compound, until the mass is somewhat stiff and elastic at a normal temperature of about 78° Fahrenheit. This may be simply tested by removing a small quantity of the product and dropping it upon a cold surface. When it acquires a good degree of stiffness, I add about twenty-five per cent. of a refractory solvent, such as rosin-oil, and allow it to cool. Other solvents, such as turpentine, may also be added to bring it to the proper degree of fluidity for application to the wire. This application is made by means of a grooved wheel traversed by the wire, the bottom of which wheel dips in a bath composed of the compound suitably diluted in a solvent, as just referred to, the conductor leaving the wheel at a tangent, which, as described in a prior patent to Clark and Rupley, No. 687,517, dated November 26, 1901, effects an evenly-distributed coating on the wire. The coated conductor is carried through an oven, being given a sufficient exposure to not only volatilize the solvent which diluted the compound and to get rid of other compounds freed in the preliminary treatment, but to effect a partial or fractional distillation of the hydrocarbon, or more exactly the carbohydrate produced from the oil by the preliminary treatment hereinabove described. The oven-temperature may vary within considerable limits; but I have obtained the best results at a temperature of 450° Fahrenheit and upward, fine wire being produced having an exceedingly tough coating, which under repeated sharp flexure of the conductor does not crack or break at a temperature of from 500° to 550° Fahrenheit, while at 600° and upward the distillation is so severe that the resulting residuum on the wire becomes brittle. These limits are not absolute, as the saponification or decomposition of the earlier treatment and the more or less complete elimination of certain undesirable distillates at that stage vary the rapidity of action at any temperature and permit successful coating to be done at lower temperatures.

The process may go on simultaneously with the presence of air or not, as preferred. The absence of air is not a disadvantage in the process of hardening my insulation, as I have produced satisfactory results in a neutral atmosphere—as, for example, in nitrogen or carbon dioxid or where the air has been pumped off. It would, however, be rather impracticable to attempt to entirely exclude air from the oven, and I have therefore not done so. Furthermore, a small quantity of air does not seem to be detrimental. The resulting product is a hard brilliant enamel, with a color varying from brown to black, according to the thickness. A thickness of three-fourths to one mil is jet black.

The process as herein described is easily distinguished from the common applications of oxidizing oils, such as linseed-oil, wherein the oxygen of the air exercises a controlling effect by forming linoxin or oxidation products with the oil and rendering it hard and elastic. That process is too slow for commercial use, rendering the wire expensive.

The degree of heat allowed by my process produces distillation, breaking up to a certain extent the composition of the ordinary compound by drawing off the lighter hydrocarbons or carbohydrates, either or both, and leaving behind a residuum in which the proportion of carbon is considerably increased relatively to the ordinary compound, but which still has good insulating properties. This is particularly the case in the preliminary treatment; but this distillation does not go so far as destructive distillation ordinarily does, though the compound undergoes changes due to destructive action, for example, on the glycerids.

The preliminary treatment of the oil in which the saponification I have described takes place materially expedites the process by causing the glycerids to be broken up and the glycerin and fatty acids to be set free, while the addition of the metallic oxids causes the separation to take place at a lower temperature and in larger quantities than when the treatment is carried on without them. It should therefore be understood that the oxids are not essential to the successful preliminary treatment of the oil except in so far as they promote the speed at which the glycerids are broken up at the temperature used. An increase of temperature will bring about a similar result; but it is not considered expedient to carry on the process in air at a temperature above 600° Fahrenheit.

Any desired number of coatings may be superimposed, several at least being desirable in order to conceal faults and provide a waterproof insulation. It is desirable to provide multiple coats, as a thin film does not blister under expulsion of the distillates as a thicker one would. Moreover, the exposure of the compound in films permits a quicker and more effective removal of the glycerin in the form of acrolein, since the layers are thin. The final coat may have any desirable coloring-matter applied, though the coloring due to the treatment of the compound itself is a beautiful glossy black.

The temperatures I have specified are for commercial speeds of work. Of course somewhat lower temperatures might be employed by giving greater time exposure, the distinctive feature of my process as compared with those heretofore practiced consisting in the change in the oil covering as effected solely or principally by distillation of a previously-thickened oil, the results known to me heretofore in this line having depended upon oxidation of commercial linseed-oil as the controlling principle of hardening, and my product, moreover, consists not of linoxin as sought and produced by former processes, but of a carbon compound produced by robbing the oil of glycerin and other combined and volatile components which tend to render it soft or fluid.

While I have specified in the preliminary treatment certain oxids, these are in no sense essential, as other materials which will effect a partial saponification of the oil or even a breaking up of the glycerids may be employed. As a thinning agent other materials than rosin-oil may be employed—for example, Venice turpentine or other solvent having a high boiling-point.

Wire insulated as herein described withstands a high heat without softening or being otherwise injured in insulating properties, and as the coating is thin more copper may be wound in a given space than usual. It is, moreover, a good diffuser of heat and withstands charring better than fibrous coverings of cotton or silk.

Referring to the drawings, 1 represents a heater beneath which is arranged a burner 2. The products of combustion may lead from a pipe 3 into the oven. A blower 4 keeps a stream of hot gases in movement through the pipe system of the heater, which is carried thence by a pipe 5 to the oven, in which a uniform temperature is thus maintained. This oven may be of any approved construction, but is preferably connected by supply and return pipes with the blower, thus forming a closed system for circulation of the hot gases, mainly carbon dioxid. I prefer to arrange it vertically, as a better distribution of the flame is thus produced. This oven is provided with dampers 6 6^a, &c., at different vertical points, which may be adjusted to gage the heat. The wire is led over a number of sheaves 7 7^a, &c., at the top of the oven and carried over coating-sheaves 8 8^a, &c., the lower ends of which dip into a bath of the compound which I have described. One of these coating-wheels may be provided with a bath containing coloring-matter or a mixture of coloring-matter and insulating compound, as indicated at 9. The wire is taken any desired number of times through the oven and may be given any desired number of coats, being then led off to a suitable reel. The height of the oven, other things being equal, determines the speed of the process. I have obtained excellent results with an oven twenty-five feet high.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The process of insulating an electrical conductor consisting in coating it with a film of oil which has been substantially freed from the glycerin of combination, and then hardening the coating.

2. The process of insulating an electrical conductor consisting in coating it with a compound of saponified oil substantially freed from glycerin and then hardening the coating by heat.

3. The process of insulating an electrical conductor consisting in coating it with a compound of saponified linseed-oil substantially freed from glycerin and then hardening the coating by heat.

4. The process of insulating an electrical conductor consisting in coating it with a film of saponified oil substantially freed from glycerin and then hardening the coating by driving off the lighter compounds from the oil.

5. The process of insulating an electrical conductor consisting in coating it with a film of previously-thickened vegetable oil and then hardening by further driving off the remaining lighter carbohydrates from the oil.

6. The process of insulating an electrical conductor consisting in substantially freeing a quantity of vegetable oil from glycerin, coating the conductor with a film of the resulting product, and then hardening the coating by heat.

7. The process of insulating an electrical conductor which consists in setting free the glycerin and fatty acids in a quantity of linseed-oil, driving off the glycerin, applying a film of the fatty acids to the conductor, and then hardening the film by heat.

8. The process of insulating an electrical conductor, consisting in dissolving an oil previously thickened by driving off glycerin in a suitable solvent, applying a film of the solution to the conductor, and hardening the coating by heat.

9. The process of insulating an electrical conductor consisting in dissolving a vegetable oil previously thickened by heat in a refractory solvent applying a film of the solution to the conductor and hardening the coating by raising to a temperature to effect distillation.

10. The process of insulating an electrical conductor consisting in coating it with a solution of a previously-thickened and partially-decomposed vegetable oil in a suitable solvent, and then hardening the coating by volatilizing the solvent and driving off the lighter compounds from the oil.

11. The process of insulating an electrical conductor consisting in partially decomposing

an oil by heating at a high temperature to produce an elastic residuum, dissolving said residuum in a suitable solvent, applying the solution to the conductor, and hardening the coating by raising to a temperature approaching destructive distillation.

12. The process of insulating an electrical conductor consisting in mixing with an oil one or more oxygen-carrying oxids, partially decomposing the oil by heating at a high temperature to drive off glycerin, dissolving the residuum in a suitable solvent, applying the solution to the conductor and hardening the coating by heat.

13. The process of insulating an electric conductor consisting in mixing one or more metallic oxids with a vegetable oil, boiling the mixture to break up the glycerids and free and drive off the glycerin, dissolving the residuum in a suitable solvent, applying the solution to the conductor and hardening the coating by raising to a temperature approaching destructive distillation.

14. The process of insulating an electric conductor consisting in mixing one or more metallic oxids with linseed-oil, maintaining the mixture at a temperature above 500° Fahrenheit until it becomes stiff and elastic at ordinary temperatures, dissolving the stiffened mass in a refractory solvent, coating the conductor with the solution and hardening the coating by heating it above 425° Fahrenheit.

In witness whereof I have hereunto set my hand this 13th day of December, 1902.

GEORGE H. RUPLEY.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.