Nov. 24, 1925. 1,562,846

C. Q. PAYNE

ANTIFRICTION MATERIAL AND METHOD OF MAKING THE SAME

Filed Feb. 5, 1923

Fig. 1.

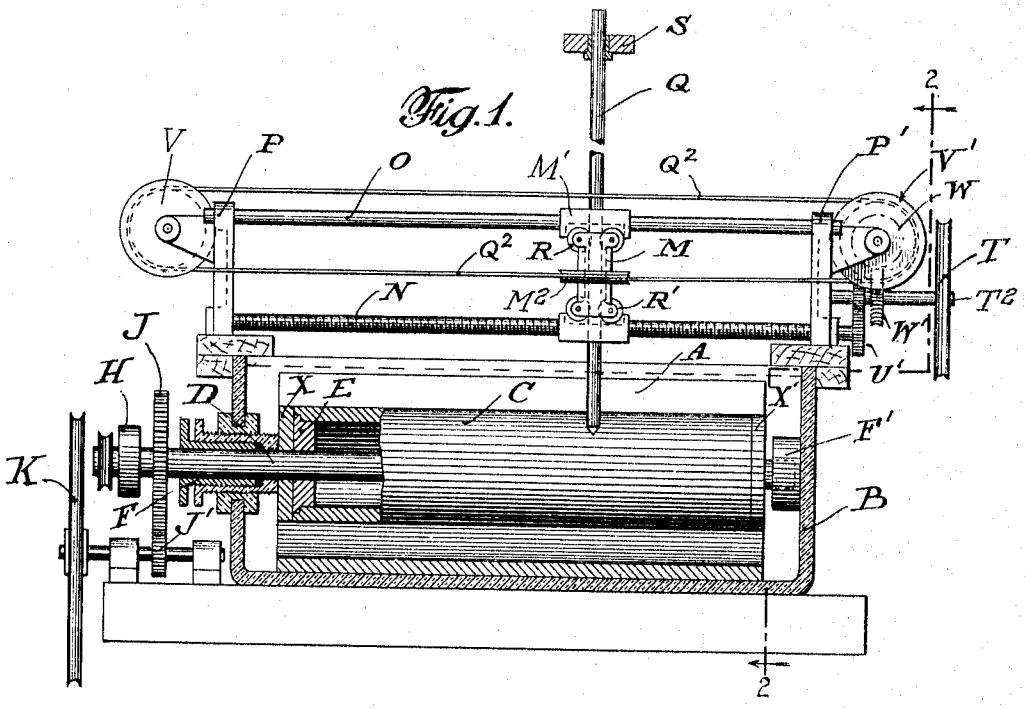


Fig. 2.

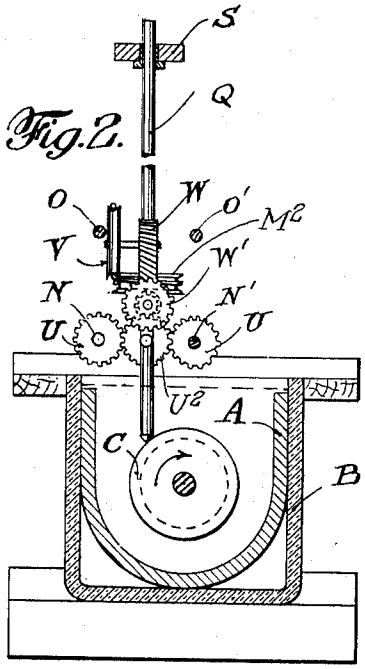
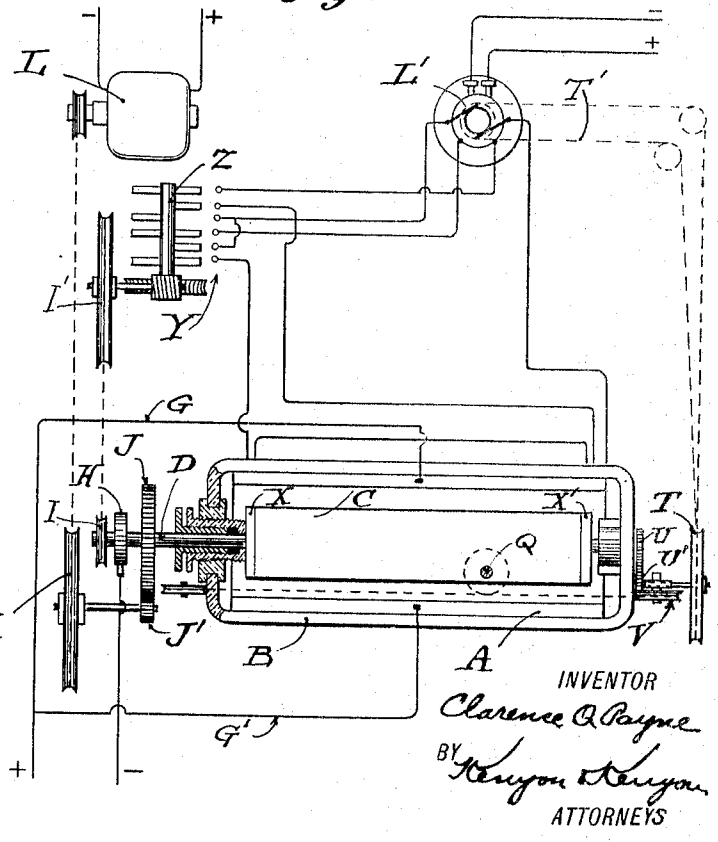


Fig. 3.



INVENTOR
Clarence Q Payne
BY Kenyon & Kenyon
ATTORNEYS

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UNITED STATES PATENT OFFICE.

CLARENCE Q. PAYNE, OF NEW YORK, N. Y.

ANTIFRICTION MATERIAL AND METHOD OF MAKING THE SAME.

Application filed February 5, 1923. Serial No. 617,175.

To all whom it may concern:

Be it known that I, CLARENCE Q. PAYNE, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Antifriction Materials and Methods of Making the Same, of which the following is a specification.

My invention relates to that class of metal compounds or aggregates, other than alloys, which are designed to reduce the friction of of surfaces moving in contact with each other.

An object of my invention is to provide a material for rotating or sliding surfaces that will withstand heavy bearing pressures without sudden seizing or sensible abrasion, and at the same time without heating to a degree which would cause oxidation or alteration of the form or constituents of the bearing metal.

A further object of my invention is to produce an anti-friction metal aggregate which shall not only have a low co-efficient of friction, but also one which can be varied within wide limits to adapt it to different applications.

A further object of my invention is to provide a method of manufacture for antifriction material which will permit wide choice of metals composing it as well as full control over the relative proportion of the lubricating mineral incorporated therein, and which is inexpensive in practice.

Other and further objects and advantages of my invention will appear from the following description of material embodying my invention and certain examples of methods of producing that material in accordance with my invention, these examples being given for the purpose of more fully disclosing my invention.

In accordance with my invention a coherent aggregate of a metal with a mineral sufficiently soft to act as a lubricant is formed by imbedding and surrounding finely divided particles of the latter in the metal preferably while the metal is electrolytically deposited from its solution. Any metal which can be conveniently brought into solution and deposited by electrolytic action, such as iron, copper, chromium, zinc, lead, aluminum, etc., may be employed in attaining the objects of my invention. Of these metals iron has an advantage in economy of first cost, and also of strength to resist compression. The compressive strength of iron is over 60,000 pounds per square inch, while that of pure copper is about 42,000 pounds, zinc about 30,000 pounds, and aluminum about 20,000 pounds. An iron aggregate has also the advantage of a high magnetic permeability and can therefore be used for the friction surfaces of clutches, etc., in which the magnetic flux is made to pass through the surfaces while moving relatively to each other when strongly pressed together. The other metals, however, have special advantages in aggregates for lubricating purposes, in those cases where a very low coefficient of friction is required.

The lubricating mineral which is preferred for the metal aggregate is graphite, since it is inexpensive and is readily available in pure form. It has a high lubricating value as it is capable of subdivision into extremely thin plates and scales. It may be added to the metal in the form of finely divided particles by attrition of the graphite by and upon the metal surface, as the metal and graphite move in contact under pressure.

The metal aggregate may be formed by introducing into metal (e. g. iron) as it is deposited electrolytically, particles of lubricating material (e. g. graphite), the process continuing until a body of the aggregate is produced of any desired shape or size or form. I prefer to introduce the lubricating material into the body of the aggregate by depositing the metal electrolytically upon a rotating cathode from a solution containing it. A pencil, rod or other piece of the lubricating material is pressed against the rotating cathode and moved at an angle to the direction of motion of the surface of the cathode. The lubricating material is thus removed from the pencil, rod or other piece thereof by attrition and distributed in a spiral line over the surface of the cathode. When the pencil, rod or other piece of lubricating material has been moved to one end of the cathode its direction of movement is reversed and it is distributed over a second spiral line all parts of which are at an angle to and intersect the preceding spiral line of lubricating material that has in the meantime been covered with electrolytically deposited metal. Other methods of introducing the lubricating material into the body of the aggregate may be employed but the

specific example described has the advantage of preventing any clouding-up of the electrolyte and insuring adherence of the constituents of the aggregate.

The amount of graphite to be introduced will depend upon the purpose for which the metal aggregate is to be used, and the coefficient of friction desired between the surfaces in contact. In general, the greater the amount of graphite introduced the lower will be the coefficient of friction of the aggregate. For the purpose of more clearly illustrating my invention, I have shown in the accompanying drawings one method of incorporating a lubricating material such as graphite in a metal such as iron, while the latter is being electrolytically deposited. The drawings are to be taken as merely illustrative and in no way limiting the invention either as to the construction or the materials used.

In the drawings,

Fig. 1 is a transverse vertical section of the assembled apparatus.

Fig. 2 is an end section on the line 2—2 of Fig. 1.

Fig. 3 is a plan view, certain parts being in section and with the diagrammatic illustration of the electric wiring system used.

Referring to drawings in detail, I have shown an anode A in this instance formed of iron placed in a tank B which tank is made of some non-conducting substance as glass, earthenware, or the like. The cylindrical cathode also of iron is supported on the shaft D by means of drum heads E and is supported by bearings FF′ on the tank B, one of which bearings forms a stuffing box which passes through one end of the tank in order to permit rotation of the cathode without leakage at the joint. The bearing members should be made of some non-conducting substance, as bakelite or the like, so as not to be subject to the electrolytic disposition taking place within the tank. Non-conducting disks XX′ preferably of bakelite or the like are supported on shaft D at the ends of the cathode for a purpose hereinafter referred to. The electrolyte may be either a ferrous sulphate, or a ferrous chloride solution. The latter is preferable where a very pure iron deposit is desired. The tank is filled with the electrolyte to a level which permits the anode and cathode to be completely submerged. Electric current from an outside source of power of suitable amperage and voltage for the metal to be deposited, is conveyed by means of the wires GG′ to the binding posts of the anode and to the collector ring H mounted on the shaft of the cathode C from which ring the current is conducted by means of suitable brushes and wiring back to the source of power as shown in Fig. 3. The electrolyte is preferably maintained at a temperature of about 150° F. by any suitable means such as an electric grid, a steam jet, etc. The cylindrical cathode is caused to rotate at a moderate rate of speed by means of the speed reducing gears JJ′ and pulley K driven from the motor L. When the electric circuit is closed so that it passes through the electrolyte at a proper current density, while the cathode is maintained at a constant speed of rotation, a smooth layer of metal, in this case iron, is then deposited upon the surface of the cathode. This layer continues to build up so long as the current continues to flow through the electrolyte and to convey the metal from the anode to the cathode.

It is quite possible to vary the above practice by using an insoluble anode such as graphite instead of a soluble anode such as iron, and to circulate the electrolyte through an outside tank where the strength of the solution is renewed by the addition of salts of the metal to be deposited. The latter practice is especially desirable in the case of those metals, such as chromium, etc., which are somewhat more expensive to obtain in the metallic form than as chemical compounds, or salts of their metals.

For the purpose of movably supporting the material to be incorporated into the electrolytically deposited metal, I provide feed screws N, N′ and supporting bar O, O′ mounted in the frame members P, P′, the screws and rods extending longitudinally of the tank B and above the same. The screws N, N′ have keyed or otherwise suitably screwed thereto suitable gears U, U′. A traveling carriage M′ supports the rotating carriage and is movably supported by the rods O, O′ and screws N, N′. The pencil rod Q of graphite in this instance is supported for vertical movement by means of rollers R in the rotating carriage member M so as to rotate therewith. The carriage member M has mounted thereon the pulley M^2 hereinafter referred to. The pencil or rod Q of lubricating material is thereby supported for rotating and transverse movement preferably at one side of the axis of the cathode as shown in Fig. 2. A suitable weight S may be mounted on the rod Q to give it any desired pressure against the cathode.

The screws N, N′ and pulley M^2 may be rotated from the motor L through suitable gearing, clutches, etc. but I deem it preferable to use a separate motor L′ for this purpose. Power is transmitted from the motor L′ to the pulley T by any suitable means as cable T′. The pulley T is mounted on shaft T^2 carried by frame member P′, the shaft having gears W′ and U^2 to rotate respectively the worm gear W and gears U, U′. A pulley V′ is rigidly mounted on the shaft carrying gear W and a cooperating pulley V is mounted on the other end of the

frame. The cable Q^2 carried by the pulleys V, V' enwraps the carriage pulley M^2 whereby the pencil or rod Q is caused to rotate by the cable.

I have illustrated diagrammatically a system of wiring whereby movement of the traveling carriage may be halted and reversed. To this end the shaft D is provided with a pulley I connected by cable to a pulley I' which rotates shaft Z through suitable reducing gearing. The shaft Z carries segments cooperating with a flasher Y whereby during a certain period of the rotation of shaft Z the motor L' is caused to rotate in one direction for example to cause the traveling carriage M' to move to the left and at another period the movement of the carriage is reversed by changing the polarity of the motor. The carriage M' may carry a suitable arm (not shown) whereby to stop the operation of the motor L' when the rod Q comes in contact with the disk X or X'. The motor L' is thereby stopped until the motor is reversed by the flasher Y whereby the motor is caused to rotate in the opposite direction until the circuit is again broken when the traveling support M' reaches the other end of the cathode.

This mechanism for controlling the operation of the motor L' comprises a flasher and circuit breaker and is shown diagrammatically only as the details thereof form no part of the present invention.

In operation of the apparatus the cathode C which is to be operated upon to form an anti-friction bearing is mounted on the drum heads E of shaft D and the pencil or rod Q of lubricating material or other material to be embedded in the metal is placed in position to bear on the cathode C. The electric circuits to the anode A, motor L and motor L' are closed so that there is a continuous deposit of material on the cathode C and due to the transverse and rotating movements of the rod or pencil Q a narrow helical path of graphite is deposited upon the cathode surface. The amount of graphite disseminated throughout the metal may be varied by selecting any desired weight S, and by controlling the speed of the moving parts by selective gearing or by electrical controls for the electric circuits.

If desired as in case considerable thickness of material is to be deposited the above procedure may be slightly varied by raising the graphite rod Q by suitable guides (not shown) so as to bring it out of contact with the cathode at each end thereon, instead of allowing its point to rest upon the non-metallic disks X, X', during the periods of interruption of its travel and rotation.

A special advantage that my anti-friction metal aggregate has over anti-friction alloys and aggregates that consist of various metals and minerals combined by melting them at a high temperature lies in the fact that the characteristics of the constituents are preserved by my method of production. When melted at a high temperature in the presence of a considerable amount of graphite or carbon in any form, many of the metals like iron, copper, etc. form on cooling chemical combinations or alloys with the carbon such as cementite in the case of iron, ar copper-carbide in the case of copper, etc. These compounds are not only extremely hard and therefore tend to increase abrasion along surfaces in contact with them, but they also render the metal brittle and difficult to machine. By my invention, on the other hand, the iron deposited by electrolysis is practically pure iron, or ferrite, which has a chemical composition of about 99.9% iron. No chemical reaction takes place between the iron and the graphite during the process of electrolytic association, and the aggregate is after a gentle annealing easily shaped and machined. By thus avoiding any hard by-products of fusion, the aggregate is best able to accomplish the purpose of an anti-friction metal. In this way it can be given wide applications and adapted to many uses not heretofore available for an anti-friction metal or alloy.

While I have designated graphite as the preferred lubricating mineral in the anti-friction metal aggregate owing to its general effectiveness and economy, yet I do not desire to confine the scope of my invention to any specific mineral for this purpose. There are other minerals such as molybdenite and talc which might also be employed for the same purpose, even though not so generally available. The mineral molybdenite for example is somewhat softer than graphite, has a fine, flaky structure and a greasy feel.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A metal and mineral aggregate comprised of a body of metal with portions of the mineral embedded in the metal in spiral lines.

2. A metal and mineral aggregate comprised of a body of metal with portions of the mineral embedded in the metal in spiral lines, the spiral lines extending gradually from a point within the metal toward the surface thereof.

3. The method of producing an anti-friction material which consists in bringing the metal into solution, electrolyzing it by means of an electric current and disseminating and enclosing a lubricating material into the metal during the electrolytic deposition of the latter.

4. The process of producing a chemically uncombined aggregate which consists in embedding particles of one substance through-

out another during electro-deposition of the latter.

5. The method of producing an electrolytic mineral aggregate which consists in bringing a metal into solution, electrolyzing it by an electric current and disseminating and enclosing a lubricating mineral in fine particles in the metal durnig the process of its electrolytic deposition.

6. The method of producing an electrolytic mineral aggregate which consists in bringing iron into solution electrolyzing it by means of an electric current, and disseminating and enclosing graphite in fine particles in the iron during the process of its electrolytic deposition.

7. The method of producing an anti-friction material which consists in depositing a metal electrolytically while distributing lubricating material over successive surfaces of the metal being deposited.

8. The method of producing an aggregate material which consists in depositing a metal electrolytically and relatively moving the metal being deposited and lubricating material pressed into contact therewith to distribute said lubricating material upon the metal being deposited by attrition.

9. The method of producing an electrolytic mineral aggregate which consists in bringing a metal into solution, electrolyzing it by means of an electric current, rotating the cathode upon which the metal is being deposited and distributing a lubricating mineral in fine particles upon renewed surfaces of the cathode along spiral lines by pressure and attrition.

10. The method of producing an electrolytic mineral aggregate which consists in bringing iron into solution, electrolyzing it by means of an electric current, rotating the cathode upon which the iron is being deposited, and distributing graphite in fine particles upon renewed surfaces of the cathode along a spiral line by pressure and attrition.

In testimony whereof, I have signed my name to this specification.

CLARENCE Q. PAYNE.