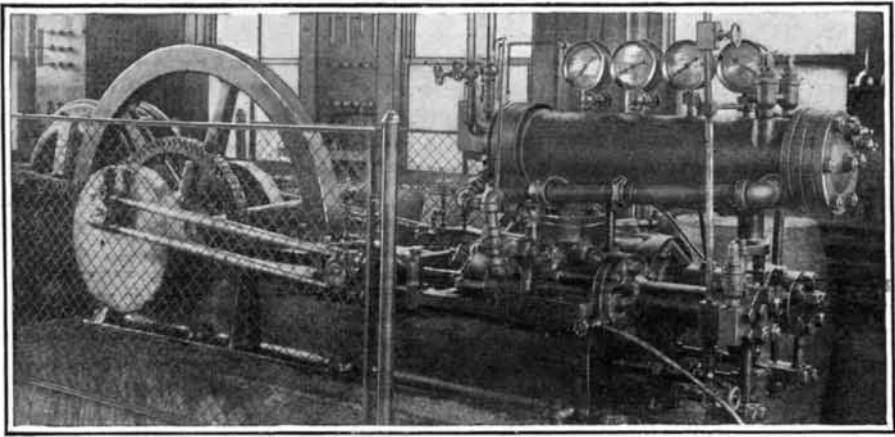


Two of the oil furnaces used in the manufacture of graphalloy



Compressor that supplies hydraulic pressure to the press used in impregnating metal with graphite

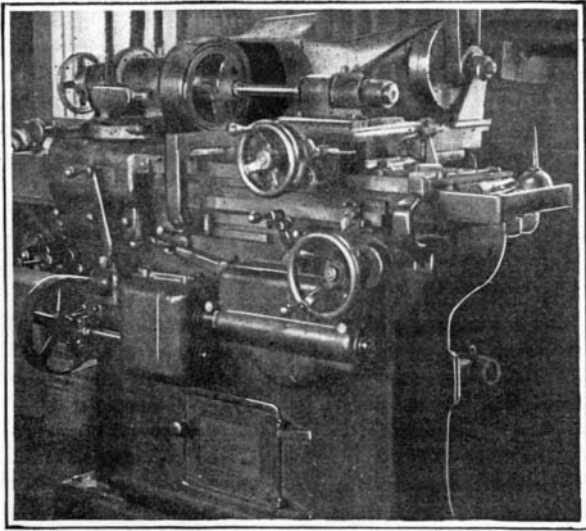
Combining Graphite with Alloy in the Manufacture of Self-Lubricating Metal

By Raymond Francis Yates

SCIENTIFIC men have long been seeking to produce a metal or alloy that will be of a soft, lubric nature and yet possess enough mechanical strength to withstand great pressures without rapid wear. Such a substance, if produced, would be of inestimable value in the realm of mechanics, when formed into bearings that would be independent of the common lubricating oil. Self-lubricating bearings made of such an alloy would find wide and profitable use, not only in machinery, which, outside of lubrication, needed only little attention, but in industries where lubricating oil forms an undesirable necessity. This is notably the case in the manufacture of textiles. Another factor which would offer firm support to the use of such bearings is the present high cost of lubricating oil, which forms a large item of expense in every manufacturing establishment.

It is a well-known fact that graphite possesses wonderful self-lubricating qualities, and that it would form a perfect anti-friction substance in the manufacture of bearings were it not for its being so fragile as to prevent it from bearing any appreciable mechanical stress. This disadvantage has been partially overcome by an American concern which has succeeded in increasing the mechanical strength of graphite by properly impregnating it with metal, thereby combining the self-lubricating properties of the graphite with the tenacity of the metal used. The resulting substance has made its appearance in the commercial market, and while its use is at present restricted to bearings of limited size, its production forms an interesting and practical achievement in the field of lubrication. It is certain that radical improve-

ments will take place in the production of the new substance that will broaden its scope of application, and even in its present state of perfection there is the possibility that it marks the beginning of the evolution of a perfect anti-friction alloy.



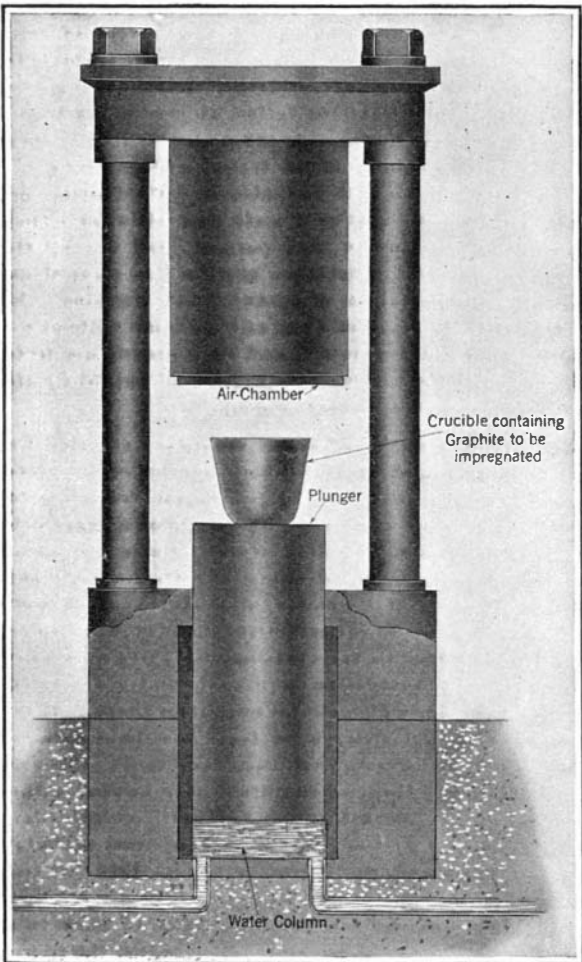
Grinder employed for finishing off bushings made from tubing

Graphalloy, as the substance is known for want of a better name, is not injured in any way by oil; in fact, its effects are entirely favorable. In some instances where the duty is rather severe, oil is used in connection with graphalloy, the latter affording a factor of safety in preventing seizing or sticking of the bearings should the oil supply fail. This is particularly true in loose pulley service, for which the new composition is largely used.

The graphite used for impregnation must be in the

solid condition and absolutely free from foreign matter in the form of grit. It is generally in the form of plates or rods, of a porous character and of uniform texture. For very light duty service pure Acheson graphite is used, and the resultant product can be readily machined with steel tools in an ordinary hand screw machine. For heavier service, however, it has been found necessary to use a graphite containing a small percentage of carbon. The carbon content gives the necessary hardness and durability. The product obtained with the latter material is rather difficult to machine in quantity with steel tools, because of the fact that it tends to dull the tools rather rapidly. For this reason small bushings are manufactured from tubing by means of diamond-point tools, whereas bushings for shafts one inch in diameter and upwards are machined both internally and externally on an internal grinding machine.

The graphite to be impregnated is first placed in a crucible of the same substance, together with the molten metal with which the graphite is to be impregnated. The crucible is then placed in the cylinder of a large press and a partial vacuum created simultaneously with an application of heat that tends to expel the air from the pores of the solid graphite, previous to forcing the metal in. Upon the completion of this operation, air is admitted to the cylinder of the press containing the crucible, under a pressure equivalent to a million pounds. The plunger of the press, on which rests the crucible, is also forced up by hydraulic pressure and the molten metal entirely impregnates every available interstice and pore of the graphite.



Arrangement of the apparatus in the manufacture of graphalloy

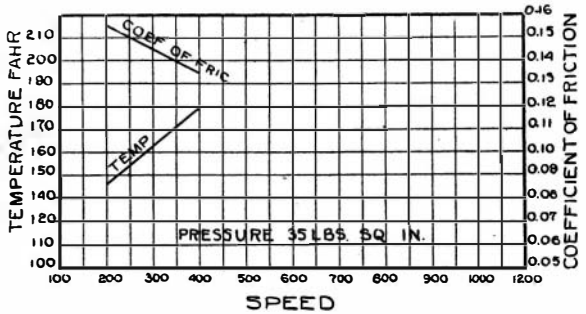


Fig. 1. Results of a test with bearings, using 35 pounds pressure

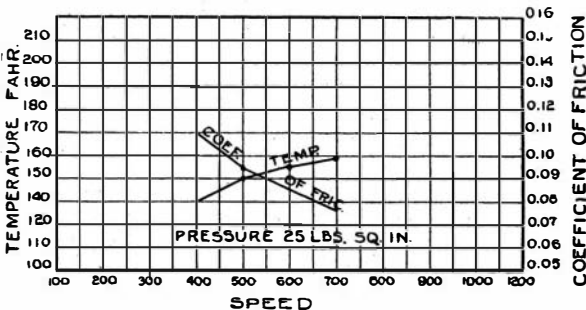
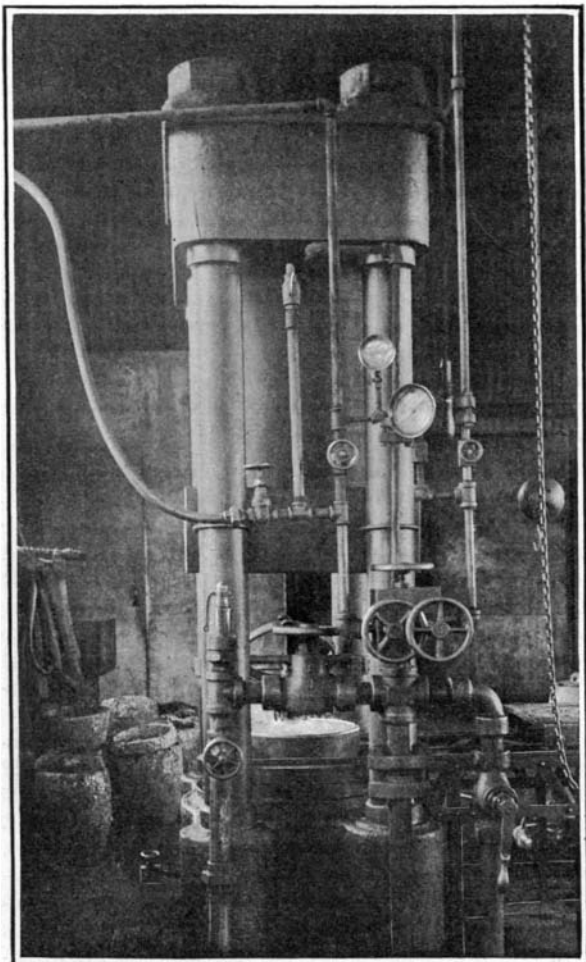


Fig. 2. Results of a test with bearings, using 25 pounds pressure



Hydraulic press employed in impregnating molten metal with graphite

After impregnation the graphite is found to have absorbed metal enough to increase its original weight approximately 150 per cent, which is equivalent to nearly 60 per cent of metal, or, by volume, 25 per cent.

For most bearing purposes, graphite impregnated with babbitt, or babbitt-graphalloy, is used. This composition is machined into bushings which are independent of oil lubrication in light duty service. When used absolutely without oil the following formula indicates the limits of service for which these bushings can be used:

Surface speed of shaft in feet per second, multiplied by the pounds per square inch of pressure on the projected area of the bearing, should not exceed a constant of about 200.

Under these conditions the bearings will be operated at reasonable temperatures and are said to be extremely durable. In cases where the oil supply is intermittent or neglected, graphalloy will far outlast an ordinary metal bushing. The most favorable usage of any self-lubricated bushing is in cases where the bushing itself revolves, as in loose pulleys, for which the graphalloy bushings are largely used. Among other usages might be mentioned vertical shaft bearings, light duty conveyor bearings, bearings for fans, small motors, idler pulleys and all sorts of bearings in special machines where it is desirable to eliminate oil lubrication.

Graphite, when metallized with copper, has found broad use in the electrical field, as contacts and brushes for motors, generators and converters. It is evident that such a substance would make ideal brushes and contacts for electrical work, owing to the great heat-resisting and lubricating properties of the graphite, combined with the mechanical durability and electrical conductivity of the copper. The principal usages of the copper-graphalloy are in contacts for controllers; oil switches and circuit breakers; brushes for automobile starting generators and motor generators; and slip ring brushes for alternating current motors.

To obtain accurate data concerning the lubricating qualities of graphalloy, several careful tests were carried out at Columbia University with a friction testing machine of the Thurston design. The bearings used were small (1.315 inches in diameter and 1.52 inches in length), but accurately made and used without application of any lubricating oil. The results obtained gave values of a surprising nature as to the coefficient of friction and operating temperature. One test was made with a pressure of 35 pounds per square inch or a total pressure of 140 pounds, at a room temperature of 76 deg. Fahr., and a speed of 200 to 400 revolutions per minute. The results of this test are clearly shown in Fig. 1. In the second test the pressure was lowered to 25 pounds per square inch or 100 pounds total, and the speed was increased from 200 to 400 revolutions per minute to 400 to 700. The results of this test were considerably different from those in the first one, as is apparent in Fig. 2.

It will be noted that the operating temperature of these bearings is much higher than those utilizing lubricating oil. The cause of this can be attributed to the relatively low heat-conducting nature of graphite, and it becomes plainly evident that the temperature of these bearings, at a definite speed, would be in proportion to the amount of graphite content of the graphalloy.

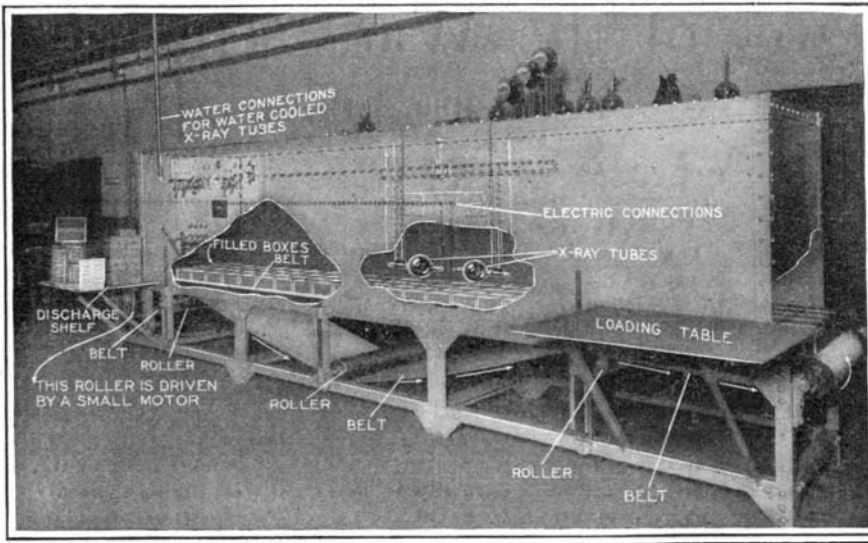
It has been found in practice that a graphalloy bearing will immediately begin to deposit a thin film of graphite on the surface of the shaft revolving within. The formation of this film is accompanied by a very noticeable decrease in the coefficient of friction, and lowering of operating temperature.

It has also been found that in no case will an excess temperature cause a graphalloy bearing to seize the shaft. This holds true up to temperatures as high as 300 to 400 deg. Fahr.

Scientific Annihilation of the Tobacco Beetle

By Robert G. Skerrett

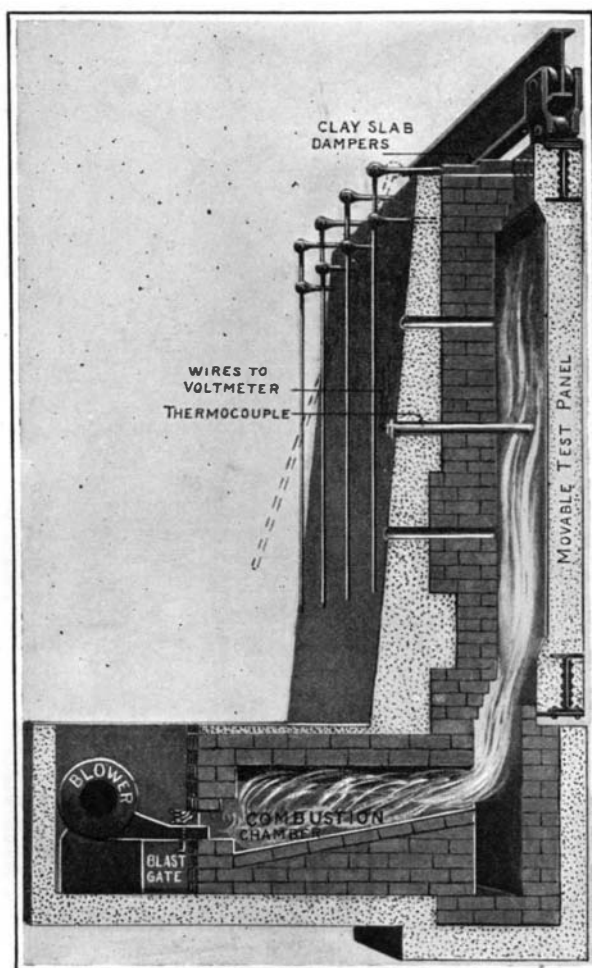
DOWN in the Southland where the "fragrant weed" grows there also flourishes a wee creature known variously to manufacturers as the "tobacco bug" and the "cigarette beetle," and to the scientist as *Lassioderma serricornia*. Name it as one will, the bug has occasioned losses to tobacco men conservatively estimated at hundreds of thousands of dollars. No wonder, then, that cigarmakers have sought far and wide for means of surely exterminating this expensive pest.



Apparatus for X-ray sterilization of cigars

Just what the problem involves can best be understood by having some general knowledge of the habits of the beetle.

The tobacco bug or worm evolves from a tiny egg which is so small that it passes unnoticed when the



Cross section showing panel undergoing test

cigarmaker handles his raw material. Unwittingly the operative works these eggs into his finished product. Later, and this incubation period depends upon the state of the weather, a white worm issues from the egg, and then, in seeking to reach the air, eats its way

right through the tobacco. This performance, of course, ruins the marketable character of the product. From the white worm is developed a small brown bug, which wings its flight usually at night. This bug, in turn, lays eggs, and thus the life history of these pests is repeated. The cigarmaker's effort is therefore aimed at killing or neutralizing the eggs. A large variety of sterilizers have been tried in the past, but only within the last few years has an effective agent been found in the form of an X-ray apparatus.

One of the foremost cigar manufacturers in Tampa, Florida, began using such a machine about five years ago. The apparatus for the plant was designed and built in Philadelphia by a well-known electrical engineering concern. Some inequalities of performance were noted, due to initial inability to control the X-ray "dosage" and to the more or less advanced stage of the larvae. The more marked the vitality of the developing in-

sect the more powerful the dosage needed to kill or to start dissolution. The enterprising firm in question has lately installed new tubes of the water-cooled Coolidge type, and it seems that these are not only susceptible of very nice control, but they have a sterilizing power which suffices either to kill the egg or to limit the life of the already developed worm to the very brief period of at most three days. In that time the worm can do but little harm, and as it is virtually moribund its appetite is a steadily dwindling one.

Heretofore, the cigarmakers have not worked the year through. They have not stocked up, but have busied themselves only when orders reached them just before the Christmas holidays. This has been the case because they feared to make up stock, only to have it injured in storage by the development and ravages of the tobacco bug. This has involved an operative handicap. In the summertime, with the windows open and the air moist, it is easy to work the leaf effectively, while cigarmaking in the drier indoor air of wintertime entails a decided loss. Now, thanks to the coming of the X-ray sterilizer, it is practicable to make up stock in the more favorable season and to store it, without fear of loss, against the coming of rush-order months.

The machine installed at the plant in Tampa is capable of handling on an average 40,000 cigars an hour. These are all selected, packed, inspected, and boxed before being passed through the machine; and after being exposed to the X-ray are not touched until handled by the consumer. The boxes are carried through the machine on a wide conveyor upon which are stacked, narrow side down, single rows of four boxes across the belt. The belt is functioned by a small electric motor, and the travel through the machine takes a trifle less than 20 minutes. During that time the steady stream of boxes moves 23 feet. The apparatus contains two X-ray tubes operating at a pressure of 45,000 volts, and current at 100 milliamperes is passed through them. The cigars are exposed to the direct rays of the tubes for a period of about four and one half minutes, but are subjected to the reflected rays for the better part

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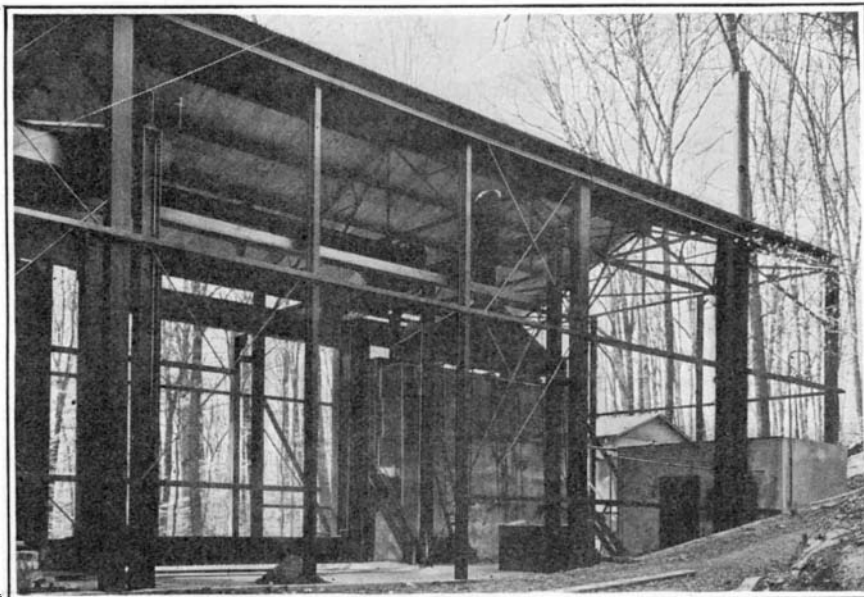
How Fire Conditions Are Reproduced in the Laboratory

THE Bureau of Standards has received a special appropriation from Congress for a study of the resistance of structures to fire, with the purpose of giving to builders and others reliable information regarding the relative fire-resistive properties of various forms of construction, and thereby aiding to diminish the enormous, and largely avoidable, fire losses in this country.

One of the important phases of this work is the investigation of the resistance of walls and partitions to penetration by fire; for the effectiveness of this resistance often determines whether a fire will be confined to one room of a building long enough to permit firemen to reach the scene and put it under control, or whether it will spread rapidly through the building and perhaps to adjoining structures.

The Bureau has just completed the erection of the largest panel-testing plant that has ever been constructed, in which walls and partitions of various constructions are to be exposed on one side to the heat of a large furnace, and then to the action of a powerful stream of water from a fire hose. The latter test is important because a partition that has been exposed to fire for a time without being penetrated, may nevertheless have become so weakened that a powerful stream of water will

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The housing of the panel testing furnace