The Application of Babbitt Metals

Practical Suggestions on Grooving, Alignment, Anchorage and Shrinkage—Results of Casting the Metal When It Is Overheated

By L. D. STAPLIN
Manager Merit Metal Department, Great Western Smelting and Refining Co.

MANY users of babbitt metal feel that it is only necessary to procure a good grade of metal and their bearing troubles will be over. This result does not always follow, as good metal, carelessly applied, means eventual trouble in most cases. For that reason the progressive consumer should make sure that his bearings are made slowly and with careful attention to detail. Because of their added service value, bearings made in this way will return the extra cost of this thoroughness many-fold.

In service, trouble is often occasioned by faulty alignment and grooving. In view of all that has been written on the subject, it seems strange that such should be the case, but it merely proves that bearing makers, as a rule, do not sufficiently realize the importance of these factors and sacrifice durability through lack of attention to them.

How To Do Good Grooving

The rules for good grooving are simple. Groove as little as possible and yet enough to distribute the lubricant evenly on the bearing's surface and particularly on that portion of the surface carrying the load, since an excess of grooving in the latter increases the pressure per unit of contact area.

All grooves should have rounded edges. Experience has taught the writer to look first for sharp corners on the grooves when trying to diagnose bearing trouble. A sharp edge left on a groove, as in Fig. 2, acts as a scraper and destroys the oil film. Round the edges as shown in Fig. 3, and the value of the lubricant is increased and the friction reduced.

When it is necessary to groove the load-carrying part of a two-part bearing, the following method has been found effective: with a boring tool or milling cutter remove the material from both edges of both halves of the bearing except for about half an inch at each end, as shown in Fig. 1, thus making an oil chamber about $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep on each side, then, at each end of the lower part only, cut a narrow groove parallel to the ends, connecting the two lengthwise recesses.

Alignment of Bearings

With sufficient patience any average mechanic can align a bearing correctly. It is only a question of willingness to take the necessary time to do a job in which it pays to be thorough. It is not enough to secure proper alignment when the bearing is made and then feel that the job is done. Before the bearing has run too long it should be examined, for in almost all cases readjustment will be found necessary because of unequal wear. If good alignment can be held, the best babbitt metal should be used on important heavy-pressure, high-speed bearings. If not, it is important to use an alloy adapted to the special conditions, having a plastic and yielding body, which will better conform to the contact surface.

Not many years ago the sale of the logging engines made by the largest iron works upon the Northwest Coast was hampered because the crankpin bearings became loose. Almost every known make of good babbitt metal was tried in an effort to find an alloy that would hold the bearings. The fault was so common that loggers objected to buying the engines. By request the writer followed two of the engines into the woods. When Sunday came, the crankpin brasses needed lining. Examination showed the simple fact that the anchors were too shallow to hold, because in service a logging

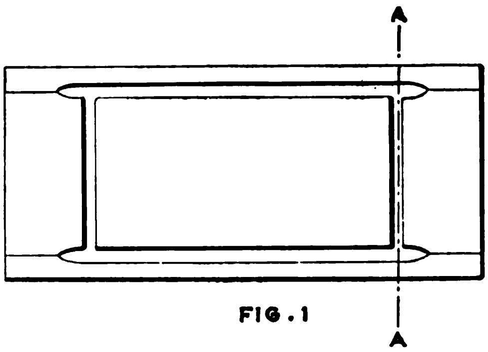
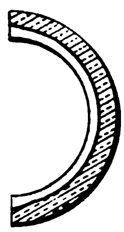


FIG. 1



Section A-A

FIG. 2

FIG. 3

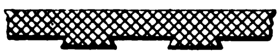


FIG. 4

FIG. 5

FIG. 1. GROOVING IN LOWER HALF OF TWO-PART BEARING. FIG. 2. GROOVE WITH SHARP EDGES, BAD. FIG. 3. GROOVE WITH ROUNDED EDGES, GOOD. FIG. 4. SHALLOW AND WEAK ANCHORAGE. FIG. 5. GOOD SOLID ANCHORAGE

engine crankpin brass is subject to extreme vibration. By making the anchorage deeper and using a little different style of anchor (see Figs. 4 and 5) the trouble was entirely remedied. The incident shows how simple seemingly serious bearing troubles frequently are. When trying to remedy loose liners, it will pay to examine the anchorage first.

If the service is at all severe, there should be close contact between the container and the liner. Even though the anchorage is right, experience may prove that soldering or tinning is desirable, and this can be done in the following manner, using a solder of 50 per cent tin and 50 per cent lead.

For tinning brass shells the first step is the removal of grease, dirt and other foreign matter from the shells by heating them, being careful not to overheat the material of the shell or the subsequent tinning will be difficult. A good way to remove oxide scale and to produce a good clean surface is to "pickle" the shells in a bath of water four parts and muriatic acid one part. In obstinate cases the most satisfactory way of preparing the shell for tinning is to machine or grind the surface to insure a clean metallic contact.

After cleaning, the surface is treated with zinc-chloride soldering solution and warmed either by plunging the shell into a quantity of melted babbitt metal or placing it over a fire. In the former case, a portion will adhere to the prepared face and can be spread over the surface later with a small brush, producing a mirror-like coating. In addition to this the hot face of the shell should be rubbed with a stick of solder and then brushed. This will give a good coating of solder on the prepared surface. If the shell is too hot, it will not take the solder well.

Tinning of steel shells may be accomplished in practically the same way, but care must be used in making the surface to be tinned perfectly clean and free from oil of any kind. Tinning of cast-iron shells is difficult ordinarily, but if sufficient care is taken to file the surface bright, just before applying the solder, a good coating may be caused to adhere.

How to Prevent Shrinkage

Metals expand on heating and contract on cooling. There is shrinkage in every bearing metal. The hotter the metal when poured the more it expands and the more likely it is to make a lining that may not adhere solid and tight to the backing. This is because of the shrinkage in the metal when it solidifies, which may be sufficient to cause it to pull away from the backing, leaving a space into which the metal can be pressed beneath the load, thus possibly cracking the lining metal and causing it to break.

The commonly given instruction, "Heat mandrel and container whenever possible before casting," is the cause of more poor bearings than any other one common casting direction. It does not make so much difference if a low-grade bearing metal is cast while it is overheated, as its high content of lead prevents much change in structure during the cooling; but if a babbitt metal of the highest grade, such as carries a tin base and considerable content of copper, is cast while overheated, the service value of the metal will be greatly reduced. A good rule to follow where durability is desired, is to cast the metal at the lowest heat at which it will be fluid enough to flow into the bearing at one pour, and against surfaces that have been warmed only enough to remove the chill. If the container or mandrel sizzles when touched with a moistened finger, it is too hot. The more dense and solid the metal's structure, the greater will be its durability, and the foregoing principle, if applied (see Fig. 6), will produce bearings of the best value in density.

To Increase Density

It is desirable to increase the density when casting removable bearings, which may be done by immersing them in cold water as soon as the metal has solidified after casting. In doing this always be careful to immerse the casting from the bottom upward and do it slowly. The spot at which the metal is poured is always the hottest part of the casting and in cooling should enter the water last. This sudden cooling will close up the grain so that under the pressure and load of service it will not "pack" or "give."

Overheating will open the grain or coarsen the structure of babbitt metal. Since "grain" only means the distance between the particles that comprise the metal's structure, it follows that beneath sufficient pressure these particles will be packed together by the weight of the load upon the metal. This makes "clearance" equivalent to the same amount of wear.

This "packing" can be avoided if the metal is dense and solid, as it will be in ratio to its temperature when poured. Necessarily, the babbitt must be made hotter for a large than for a small casting, so heat according to the work in hand and do not be afraid to spoil a couple of castings in learning the lowest heat point. Experimentation in this connection will be repaid many-fold in the time saved in rebabbitting.

A Typical Case of Overheating Trouble

To illustrate a typical case of trouble caused by overheating a high-grade babbitt metal, the following experience will serve: The writer was called to the mill of a sugar manufacturer having trouble with centrifugal bearings. Examination showed that some

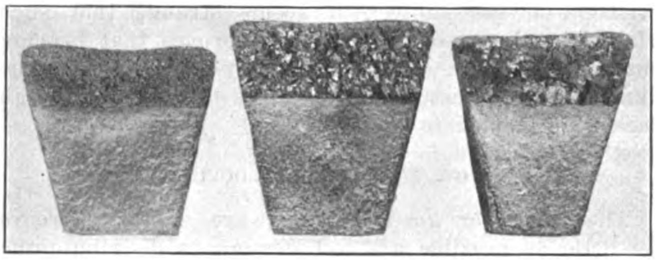


FIG. 6. STRUCTURE OF BABBITT METAL WHEN CAST AT PROPER TEMPERATURE, WHEN SLIGHTLY OVERHEATED AND WHEN GREATLY OVERHEATED

would run a full season and others in the same type of machine and made from the same metal would last only a few days. After running a few days, the metal started to slough out of the bearing. By examining one of these bearings with a glass, the metal was found to contain minute cracks which would enlarge and finally cause the metal to give way under the vibration of service. The cracks were caused by contraction of the metal while cooling, after overheating and casting against a mandrel that was too warm.

If a lead-based, moderate-priced babbitt such as is so widely used for general work is poured when overheated or against an overheated mandrel, the results, as previously explained, are not so serious. Babbitts of this class are not likely to be "ladle spoiled," and to this good point they owe considerable of their popularity. However, overheating will make them brittle and more likely to break, crack or crumble beneath heavy loads and high speeds.

A steel company was testing a certain alloy in its rolls. Two bearings were cast with the metal nearly red when poured. At the end of five days the liner was $\frac{3}{32}$ in. thinner than when the test started. It had packed that much beneath the load. The two bearings were then cast at the proper temperature, and after running for twelve days they were tested and found within a trifle less than $\frac{1}{32}$ in. of their original thickness. It was customary to reline these bearings when the liners had worn to a certain thickness; hence, by casting the metal with care, the company was able to put more tonnage through the rolls that were correctly babbitted, with a saving of time, money and annoyance.