NEW METHOD OF BUILDING LATHES

BUILDING HEAVY LATHES WITHOUT MACHINE WORK ON THE BED CASTING

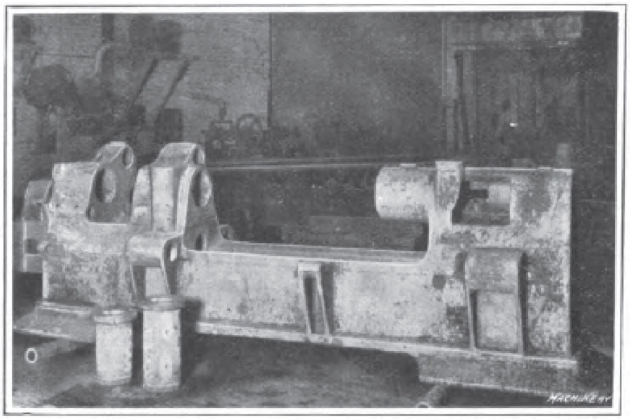

Fig. 1. Lathe-bed Casting ready to have Bearings and Ways assembled in Place. Note Headstock Spindle Bearings standing on Floor

THE use of jigs and fixtures in manufacturing machine parts has grown rapidly during recent years. This has resulted in increasing the rate of production and accurately controlling dimensions so that machine parts in general are made practically interchangeable with little hand work. But in machine tool building it has always been considered necessary to do a considerable amount of machine work on the frame castings, followed by hand scraping and fitting of bearings and similar parts where perfect fits and absolute alignment are required. This hand work takes much time and must be done by skilled mechanics; and at the present, when machine tool builders are overburdened with work and the supply of experienced men is far below the demand, these hand finishing operations are among the factors which seriously limit the output of machinery factories.

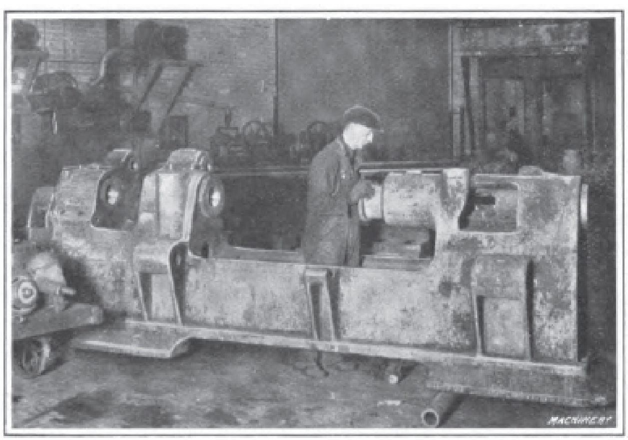

Fig. 2. Bed Casting with All Spindle and Shaft Bearings in Place. Note Truck Load of Parts at Left-hand Side of Machine

It is a matter of general knowledge that where castings are machined, the removal of the outer scale from certain sections of the casting allows the shrinkage strains in the metal to spring the casting out of shape. To overcome trouble from this source, the common practice is to take a cut over the surfaces to be machined and then set the casting aside for a sufficient length of time for it to become fully "seasoned" before the final machining operations are performed. Not only does such a method of procedure call for the expenditure of time and labor in machining, but it requires the castings to be held in the factory for a considerable period of time before they can be put into a finished machine. This is a severe drawback under conditions such as those which exist at the present time, when machinery builders are doing their utmost to secure the maximum production in their shops.

With the view of overcoming these difficulties, the Amalgamated Machinery Corporation, 72 W. Adams St., Chicago, Ill., has developed a method of lathe-bed construction, upon which patents have been granted, that virtually eliminates all machining and fitting operations, absolutely no machine work being done on the lathe beds. This result is obtained by the employment of turned and ground steel rods for the ways and cross-slides, that are supported in brackets provided on the bed and saddle castings. These rods are made of turned and ground 50 point carbon steel, and are sold under a guarantee that the error in alignment does not exceed 0.0005 inch in a length of eight feet. The headstock and tailstock are cast integral with the bed, and all spindle and shaft bearings are carried by iron bushings which are set in place in cored holes in the castings.

It will be evident that for such a construction to give satisfactory results, means must be provided for obtaining absolutely accurate alignment of all working parts, and this is done by means of an assembling jig which is dropped in place over the bed casting. This jig has brackets which fit snugly over the steel rods that form the ways, and close fitting bearings for mandrels that fit through the different spindle and shaft bearings. When all the machine members have been lined up in this way, a low melting alloy is poured into the annular spaces between the cored holes in the lathe-bed casting, and the machine members are held in these holes, so that when the molten metal has solidified, all parts are secured in

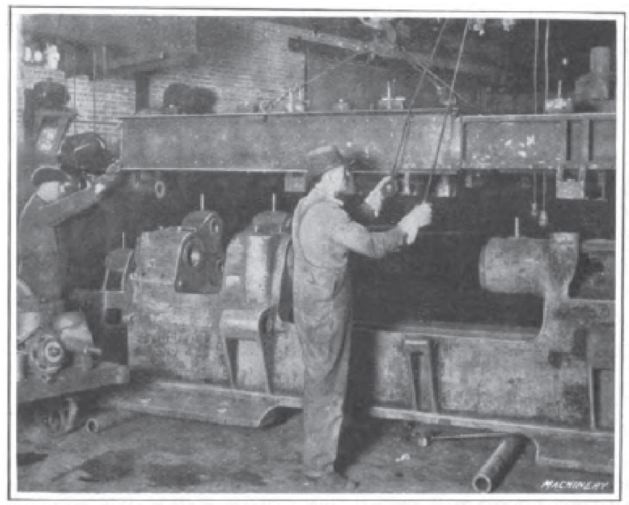

Fig. 3. Lowering Assembling Jig into Place on Casting. Note Bearings on Under Side of Jig for bringing Lathe Bearings and Ways into Alignment

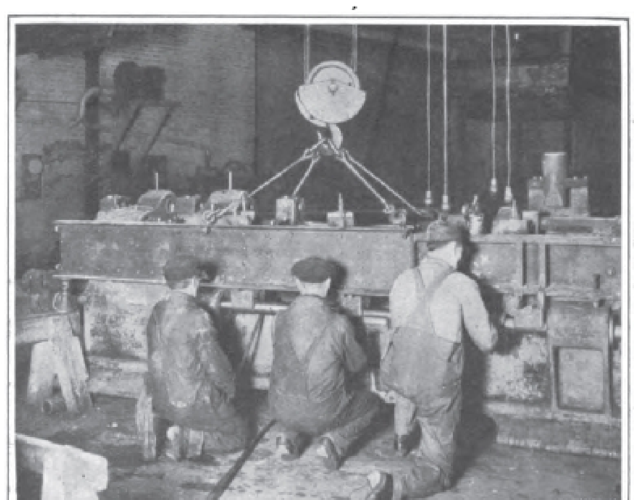

Fig. 4. Putting One of the Hardened and Ground Steel Rods into Brackets on Casting. Notice Method of Location from Bearings on Jig

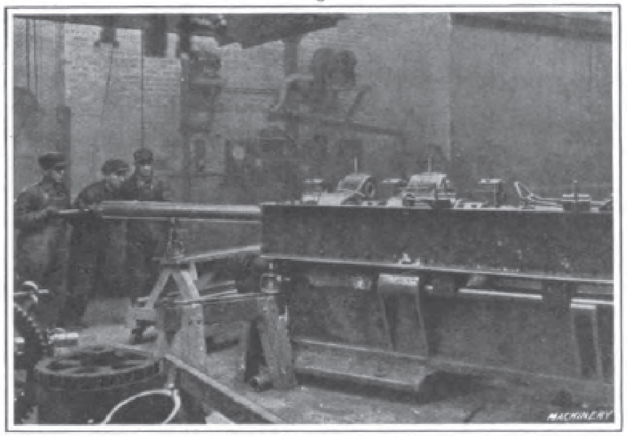

Fig. 5. Pushing in Mandrel which locates Spindle Bearings in Alignment with each other and with Ways on Lathe Bed

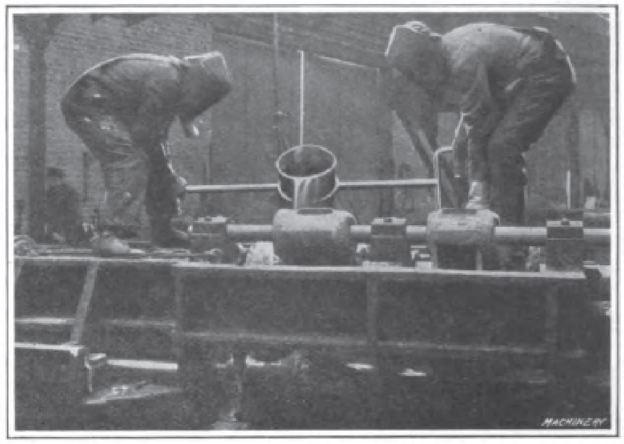

Fig. 6. Pouring Clamping Metal. Attention is called to Arrangement of Clay to hold Molten Metal in Place until it solidifies

exactly the required positions. With this brief statement in regard to the general features of the type of construction, we are in a position to proceed with a detailed description of the method of assembling.

Arrangement of the Assembling Department

In the factory of the Amalgamated Machinery Corporation, the erecting department occupies bays which are of the required width to enable the machines to be placed crosswise and leave sufficient room to handle the work advantageously. Each bay is provided with a special form of overhead revolving jib crane; and at each assembling station in the bay two jib cranes are available for handling parts that are too heavy to be readily moved by hand. The bed castings are distributed on the floor, one to each space, and a complete set of parts to be assembled on a machine are brought to each station on trucks so that all the pieces are available for instant use.

In this connection it should be mentioned that the cast-iron bushings which carry the head spindle are babbitted ready for use at the time they come to the assembling floor. It is a well-known fact that the composition of babbitt metal is changed each time it is melted, as a result of the reduction in percentage of certain constituents through oxidation. This affects the physical properties of the babbitt and in cases where the metal is remelted a number of times, its character may have so seriously deteriorated that it will no longer be capable of giving satisfactory service. In the babbitted spindle bearings used by the Amalgamated Machinery Corporation, this trouble has been effectually overcome by sending the cast-iron bushings out to be babbitted by the company which makes the babbitt metal. The practice followed is to line the bearings at the time that the babbitt metal is first compounded, so that it is poured into the bushings at once and there is no danger of securing metal of an inferior quality as the result of deterioration due to the removal of certain constituents by oxidation.

Assembling the Lathe Bed

Reference has already been made to the fact that the bed casting has the headstock and tailstock cast integral with it; and one-piece bearings are employed for both the head and tail spindles. Fig. 1 shows one of the finished lathe-bed castings with the two headstock spindle bearings standing beside it; and in Fig. 2 the bearing bushings have been pushed into the spindle and shaft holes in the headstock, and a man is shown pushing one of the bearings into place in the tailstock. After this part of the work has been done, the assembling jig is lowered into place over the bed casting, as shown in Fig. 3, after which the turned and ground steel rods that form the ways are pushed into place in the bracket holes at the front and back of the casting. The assembling jig is provided with bearings which are carefully machined to fit around the steel bars that form the ways, so that they will be located in accurate alignment with each other; and similar bearings align mandrels which are a close fit in the spindle and shaft bearings in the lathe bed so that all bearings will be located parallel to each other and to the ways. These locating bearings can be seen on the under side of the jig in Fig. 3; Fig. 4 shows the jig in place on the lathe-bed casting; and in Fig. 5 one of the aligning mandrels is being pushed into place.

Pouring the Clamping Metal

After all the parts have been properly located in the cored holes in the lathe-bed casting, the assemblers are ready to pour in the molten metal which solidifies in the spaces between these parts and the bed casting to hold them in place. A brief consideration will make it evident that the metal which may be satisfactorily employed for this purpose must possess certain characteristics. In the first place, it must neither expand

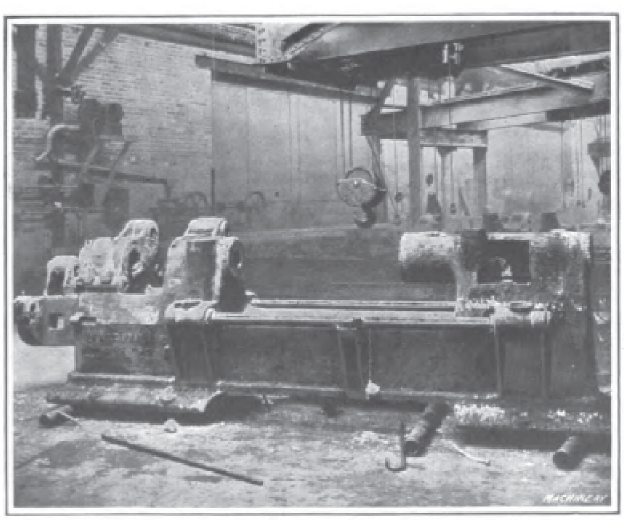

Fig. 7. Finished Lathe Bed as it appeared immediately after Removal of Assembling Jig

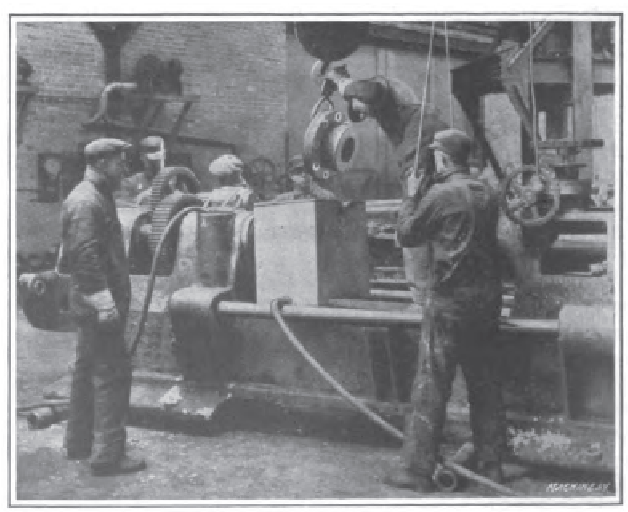

Fig. 8. Lowering Faceplate into Place ready to be heated and then shrunk onto Lathe Spindle

nor contract after being poured, as such a condition would result in either straining the casting or leaving the different machine members loose in their holes in the casting. The metal must also be of such a nature that it will not crystallize nor change its structure in any way as the result of vibration, and it must be tenacious enough to support adequately the load imposed upon it. The alloy used for this purpose was developed as a result of experimental work, and is a type metal of special composition. In order to take advantage of the peculiar properties of this metal, it must be poured at a certain specified temperature which was determined by experiment, as it has been found that a deviation of even 30 degrees above or below this temperature will result in expansion or contraction of the metal as it solidifies, which prevents obtaining satisfactory results.

To provide for accurately controlling the temperature of the metal, it is melted in pots heated with saturated steam, and an experienced metallurgist devotes all of his time to providing the assembling department with metal at exactly the required temperature. Melting pots are located at intervals down the side of the bays, and the ladles for pouring the metal are of different sizes which contain just the proper volume to fill the annular spaces without waste. The weight of each size of ladle has been carefully calculated, so that when the molten metal is poured into it from the melting pot, the ladle will absorb just enough heat to reduce the temperature of the metal from that of the melting pot, which is a little too high, to exactly the temperature at which it must be poured in order to avoid expansion or contraction while cooling.

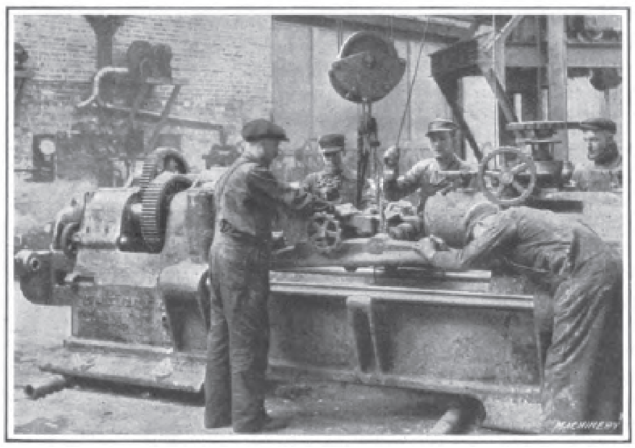

Fig. 9. Assembling Carriage onto Lathe Bed. Attention is called to Design of Carriage

It will be evident that means must be provided for retaining the metal in the space which it is desired to fill, and these means are provided by packing clay around each end of the annular space; a small cup of clay is also packed around the cored hole through which the metal is poured into the annular space to be filled. This clay is mixed and cut into ribbons, in which form it is sent to the assembling department, so it may be conveniently handled. After the clamping metal has been poured, it cools and solidifies almost instantly because of the large mass of iron surrounding each pocket. It is stated that this cooling action is so rapid that a person can hold his hand on the outside of the casting or the inside of a bearing at the time the clamping metal is poured without burning it. As a result, there is no danger of distorting the babbitt bearing liners. After sufficient time has been allowed for the molten metal to cool and solidify, the assembling jig is removed from the casting and the strips of retaining clay are scraped away. The workman then goes over the machine with a file and removes any protruding metal, but he does not attempt to hammer down the metal, as this would result in introducing strains and possibly changing the structure.

Assembling the Lathe Carriage

The lathe carriage consists of two cast-iron shoes with grooves which fit over the ways on the bed. The cross-slide on the carriage is formed by two hardened and ground steel rods which are secured in place by the method which has just been described. Assembling jigs are provided for aligning the different members of the carriage preparatory to pouring the clamping metal. The work of assembling other parts of the machine is essentially the same as in any machine tool building establishment.

The Amalgamated Machinery Corporation makes four sizes of machines and four types of each size. In order to insure interchangeability, the assembling jigs for each size of machine are made from a master jig so that all dimensions are held constant. For example, on one size of machine there are seventeen assembling jigs in use, all of which are made from the master jig. This shows the importance of having a single standard which governs the dimensions of a given size of machine. The same thing is true of the jigs used for assembling both the carriages and lathe beds. The accuracy of alignment secured is shown by the fact that out of several thousand Amalgamated lathes which are in use, no trouble has been experienced from bearings running hot. Another interesting feature of the construction is the claim made that it is impossible to make one of these lathes vibrate in a way which will cause the tool to chatter. The explanation offered is that all important bearings float on a metal which tends to absorb vibration rather than transmit it from one machine member to another. Whether or not this is the correct explanation, the fact remains that it is impossible to operate the lathe in a way which will produce noticeable chatter of the tool.

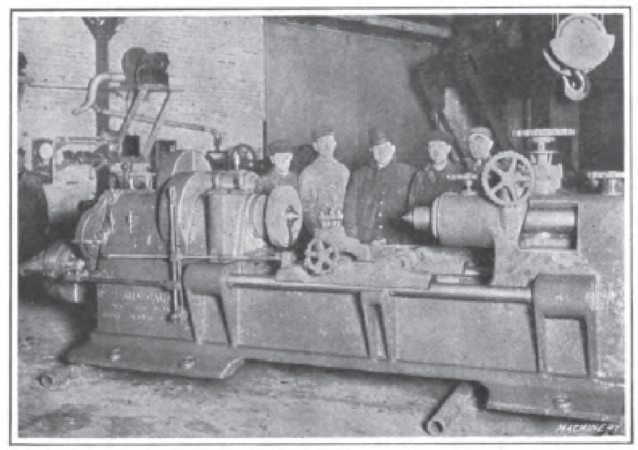

Fig. 10. Finished Shell Lathe, and Gang of Four Men and Foreman who assembled it in Six and One-quarter Hours

Other Possible Applications of This Method of Construction

Although this method of construction was developed for building shell lathes rapidly without the employment of a great amount of skilled labor, it appears to offer possibilities of application in the construction of a variety of other classes of machinery and engines. In manufacturing small machines, it should be possible to provide for forcing the molten metal into the casting under pressure in much the same way that die-castings are made. This would insure obtaining a very dense metal, and would also enable the metal to be delivered from the melting pot the same as on die-casting machines. An idea of the rapidity with which the work of assembling can be done will be gathered from the fact that in the case of large lathes weighing approximately 20,000 pounds, the entire assembling operation can be completed by a gang of four men in 7½ hours; such a gang of men assembles two complete lathes a day. Obviously such an achievement would be out of the question, were it necessary to employ hand work for scraping the bearings and ways to an accurate fit. E. K. H.

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During the past five years, the average pay of the employes of one large manufacturing concern in Detroit, Mich., has increased 32 per cent. The wages of high-class mechanics, including toolmakers, die-makers, and first-rate machinists, have increased as much as 80 per cent. This rapid rise in wages in Detroit has been partly due to the competition of the motor car manufacturers.