

2,197,259

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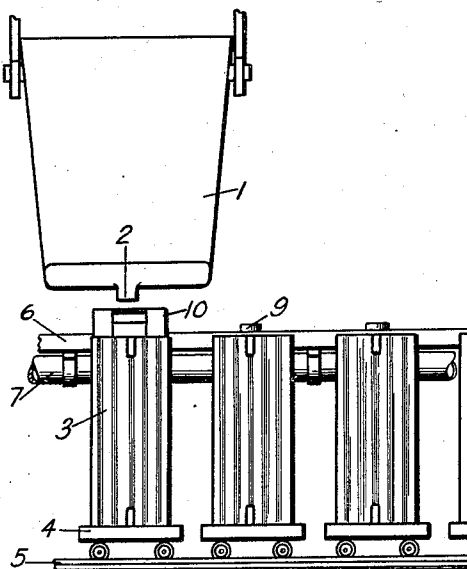


Fig. 2

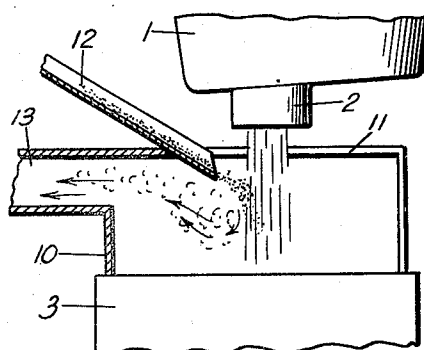


Fig. 5

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UNITED STATES PATENT OFFICE

2,197,259

METHOD OF AND APPARATUS FOR ADDING
LEAD TO STEELJohn Hunter Nead, Hammond, Ind., assignor to
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tion of Delaware

Application May 2, 1938, Serial No. 295,505

4 Claims. (Cl. 75-129)

This invention relates to a method of adding lead to steel. It has to do primarily with that class of steel which is generally referred to as "free cutting," "free machining" or "screw-stock" steel. However, it is not necessarily limited to this class of steel and has to do with any type of steel which is to be subjected to machining operations, or to any steel wherein the addition of lead is desirable for any purpose.

It has been found that steel containing lead in percentages ranging from .03 to 1.00 per cent greatly improves the machinability of the steel, particularly, when more than .10 per cent is retained in the steel. This is true whether or not the lead be introduced into the so-called "free cutting" steels or whether it be used in other types of steels. When introduced into the free cutting steels, it results in an improved machinability over and above the free cutting characteristics imparted to the steel by the sulfur and, in addition, does not impair the mechanical characteristics of the steel. When used, in adequate percentages, with steels of relatively low sulfur content as, for instance, in steels containing less than .05 per cent sulfur, it imparts improved machinability characteristics and in some instances gives free cutting characteristics which compare favorably with machinability characteristics of some of the present commercial "free cutting" steels. Moreover, the improvement in machinability by the use of lead avoids sacrifice of the mechanical properties of the steel such as occurs when the improved machinability is obtained by somewhat higher sulfur contents.

In the prior art, it has been suggested that lead be added to steel for the purpose of preventing "piping" and "blow holes" and for various other purposes. In the main, however, it has generally been believed in the art that lead is not soluble in iron and therefore that it could not be used in steel to attain any useful results. Such suggestions for the use of lead in steel as have appeared in prior patents appear to have been impracticable. In the main, they have involved the introduction of lead into the steel in the form of ingots of substantial size. Normally, when such ingots are introduced into a bath of molten steel, they immediately sink to the bottom of the bath and remain at the bottom of the bath practically without dispersion of the lead in the steel. These suggested uses of lead ingots invariably call for the introduction of such ingots either into the furnace or into the ladle. Introduction of the lead into an open-hearth furnace is, for various reasons, impracticable. Un-

der some conditions, introducing lead into the ladle used with the open-hearth has resulted in excessive fuming and inability to control the amount of lead actually dispersed throughout the molten bath. The lead separated out and settled to the bottom of the bath, even running through the nozzle, in spite of the fact that the stopper was closed.

I have found, however, that these various difficulties may be overcome by introducing the lead into the mold. This is especially so if the lead is introduced into the mold in a certain way and under certain conditions. Preferably the lead to be introduced is in sub-divided form. It may be finely divided lead ranging from 10 to 50 mesh in size or it may be small shunks of lead. On the other hand, it may be introduced in the form of lead compounds or alloys, of which the following are examples:

Lead-tin-antimony alloy-----	Ratio 1:1:1	20
Galena (PbS)-----		
Pure lead-----		
Lead-tin alloy-----	60% Pb, 40% Sn	
Lead-copper-tin alloy-----	32% Pb, 66% Cu, 2% sn	25
Litharge-----	PbO	
Lead phosphate-----	Pb ₃ (PO ₄) ₂	
Lead tin alloy-----	(1.5% Sn)	
Lead calcium alloy-----	(.5% Ca)	30
Lead bismuth alloy-----	(3% Bi)	
Lead arsenic alloy-----	(1.1% As)	
Lead cadmium alloy-----	(.5% Cd & 1.6% Cd)	
Lead tellurium alloy-----	(.1% Te)	35
Lead antimony alloy-----	(1.7% Sb)	
Lead lithium alloy-----	(.1% Li)	
Lead zinc alloy-----	(.3% Zn & .9% Zn)	
Lead sodium alloy-----	(.3% Na)	
Lead magnesium alloy-----	(.3% Mg)	
Lead-manganese-iron alloy--	(20% Pb 46% Mn (33% Fe) plus impurities)	40
PbS, FeS (64% Pb 13% Fe 17% S plus impurities)		
Pb-Fe-S alloy		45

I have found that the introduction of the lead into the steel and the dispersion thereof is rendered much more effective if such introduction occurs during the pouring of the steel into the mold. Best results seem to be obtained by first filling the mold about one-third or one-half full of steel and then introducing the lead during the last two-thirds or one-half of the mold filling operation. So far, the best results which I have obtained have been obtained by utilizing sub-

stantially pure lead in sub-divided form and delivering it by means of a trough directly against the downwardly flowing stream of steel at about the entrance to the mold. In this way, the lead is introduced as a stream of finely divided metal and mixed more thoroughly and is dispersed throughout the steel in the mold. This lead may also be introduced as a spray of molten metal. Likewise, it is possible to put the lead on top of the charge in the mold. However, my experiments to date show that, even though finely divided, the lead, when introduced at the top of the ingot or after completion of the pouring of the ingot, tends to collect into large masses and then sinks to the bottom of the mold without being effectively dispersed to any substantial extent throughout the body of the steel in the mold.

One of the difficulties arising from the introduction of lead into molten steel arises from the fact that relatively large volumes of poisonous fumes and gases are created which not only hamper operations but are, in some measure, dangerous to the workmen performing the operation. Therefore, I have devised apparatus to facilitate this operation of delivering the lead to the mold.

The apparatus which I utilize for facilitating delivery of the lead to the mold is illustrated in the accompanying drawing wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a diagrammatic illustration of a ladle shown in position for delivery to the mold together with a trough for delivering the lead and a means for removing the poisonous gases and other fumes by forced drafts.

Figure 2 is a side elevation of the elements shown in Figure 1.

Figure 3 is a somewhat enlarged perspective diagrammatically illustrating one mold with my apparatus for feeding the lead into the mold and removing the gases and fumes therefrom.

Figure 4 is a diagrammatic illustration of my lead delivering apparatus and gas removing apparatus, shown partly in section and illustrating its relation to the mold and the ladle.

Figure 5 is a detailed view of one of the connections between the forced draft apparatus and the removable hood structure which is designed for successive applications to a series of molds, as indicated.

In the drawing, the ladle is shown at 1. This ladle is of customary form and is provided with the usual nozzle 2 and the customary stopper which is not shown. A series of molds is shown, these molds being designated 3 and being mounted upon conveying cars 4 which move upon a track 5 along the edge of a platform 6.

Beneath this platform 6 is provided a conduit 7 which may be connected to an exhaust fan (not shown) or other form of means for creating a forced draft. This conduit 7 is provided at spaced intervals with upstanding ducts 8 each of which carries at its upper end a sand seal 9. These upstanding ducts 8 are preferably provided at spaced intervals corresponding to the spaces between the central areas of the spaced molds of the mold series.

I preferably use one removable hood which is generally designated 10 and which is designed for successive applications to each upstanding duct 8 and the corresponding mold of the series. This hood 10 is provided on its upper and outer surface with a cutaway portion 11 which is of sufficient area to permit free flow of the stream

of steel therethrough into the mold and simultaneous introduction of the lead by means of a trough 12 as shown. The hood is further provided with a converging extension member 13 which carries the downwardly extending duct 14 designed to be introduced into the sand seal 9 and into telescoping relation with an upstanding duct 8.

Though I have described one type of removable hood, it will be understood that various types of hoods may be used. As a matter of fact, it is within the scope of my invention to use any desired type of apparatus for removing the fumes and gases under forced draft. For example, I may use any means such as a mere vacuum or high suction slot hood which would not cover the top of the mold but would only provide a suction opening adjacent to the mold top. In fact, any type of hood or suction opening which would remove the fumes is within the scope of my invention. Likewise, it is within the scope of my invention to remove the fumes and gases by blowing air under pressure across the top of the mold or otherwise to dispel such fumes and gases.

It will be understood that it is within the scope of my invention to introduce the lead either in the form of sub-divided metallic lead, lead alloys or compounds of lead or lead-bearing minerals.

In operation, the filling of each mold is preceded by placing the hood 10 on top of the mold with its downwardly extending duct 14 in co-operative relation to the sand seal 9 and upstanding duct 8, as illustrated in Figures 3 and 5. Then, the ladle is moved into the position shown in the drawing and the stopper lifted so as to permit the steel to be delivered into the bottom of the mold in the usual manner until the mold is about one-third or one-half filled. Then, while the filling operation continues, the sub-divided lead is delivered to the trough 12 and into the mold, as indicated in Figure 4 wherein it will be seen that the lead is being sprayed into contact with the downwardly pouring stream of molten steel. Generation of the fuming gases commences as soon as the lead strikes the molten steel. However, since the forced draft is already effective through the hood 10, these gases are drawn through the duct 8 and conduit 7 as they are generated. The result is that the workmen are amply protected from these fuming gases and the delivery of lead to the steel proceeds without material discomfort to the workmen until the mold is filled, at which time, the delivery of the lead to the steel has been completed.

Having thus described my invention, what I claim is:

1. Apparatus for use in the introduction of lead into steel comprising a means for introducing lead into a container having molten steel therein and means for simultaneously removing the gases and fumes generated thereby by means of an air draft over the open end of the container.

2. Apparatus for use in the introduction of lead into steel while being poured into an ingot mold comprising a hood-like member which covers the top of the mold with the exception of an area below the nozzle of the ladle where it is provided with a cutaway portion to permit the introduction of the steel from the ladle and the lead to be combined therewith, and means for creating an air draft in said hood across the top of the ingot mold to draw the lead fumes away to a point where they will not be harmful.

3. The method of producing steel containing lead in dispersed condition, which comprises

pouring molten steel into a container therefor, gradually introducing lead in finely divided condition into said container during said pouring, and simultaneously removing gases and fumes generated by the addition of the said lead by an air current above the top of the metal in said container.

4. The method of producing steel containing lead in dispersed condition, which comprises

pouring a stream of molten steel into a mold, delivering lead in finely divided condition against the said stream of molten steel and introducing it into the mold therewith, and simultaneously removing gases and fumes generated by the addition of the said lead by an air current above the top of the metal in said mold.

JOHN HUNTER NEAD.

CERTIFICATE OF CORRECTION.

Patent No. 2,197,259.

April 16, 1940.

JOHN HUNTER NEAD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, lines 20, 21 and 22, in the table, for

"Lead-tin-antimony alloy-----	} Ratio 1:1:1
Galena (PbS)-----	
Pure lead-----	

read

Lead-tin-antimony alloy-----	Ratio 1:1:1
Galena (PbS)-----	
Pure lead-----	;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of June, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.