CHAPTER XVII

LOOSE PLUNGERS
LINECASTING METAL

Symptoms of a Loose Plunger

What are the symptoms of a loose plunger?

1. Metal boils up from the well when the plunger descends. Occasionally this will happen on a good plunger with a strong plunger spring, but

2. Measure the plunger itself. If it is smaller than 1.996″ at any spot across the bottom (or top), it is probably too loose for a good cast.

3. A tendency to hollow slugs, especially on 12-point and 14-point slugs.

(Note that this is not the hollow slug that results from recasting or excessive heat, nor yet the hollow shell that appears gradually when the plunger sits below the holes in the well. This condition will show up on practically the first slug cast. Break the slug with your fingers. You will see hollow places inside. The weight, of course, is a giveaway. Pick up a handful of slugs and heft them. Check heat and metal level. It is well to note here that the slug cast from a pot with a very low metal level will be distinguished by a perfect bottom and exterior but an extremely hollow interior.)

4. The base of the loose-plunger slug will sometimes have actual holes where the mouthpiece holes should be seen, says Harding.

5. Changing the temperature or the plunger spring has little effect on a loose-plunger slug.

Remedy for a Loose Plunger

Question: Our plunger is loose and will not cast a solid slug on 14-point. An operator in a neighboring town has advised me to get a reamer and enlarge the well; then, he says, I can get a selection of oversize plungers and use the one that fits. Do you think this will end my trouble? — S.T., Wewoka, Okla.

Loomis: In the 1930's, following the widespread use of 14-point in country shops, I began to take cognizance of a common situation created by a loose plunger. On 8-point, 13 picas, or even 30 picas, the machine would deliver a good slug, but on 14-point, 30 picas — and this was especially true with the solid molds which were generally used at that time — the results were not good. The machine often formed a slug which was hollow and which actually would cave in on a 10x15 platen press.

At that time the only remedy was to buy a new crucible and plunger, and the parts plus installation would represent around $200, not to mention considerable disruption of the office. Before long a number of service companies evolved systems of boring the wells on a lathe or drill press, but this involved either considerable delay or expensive trade-ins.

At that time, too, various manufacturers put on the market, for sale or rental, reamers designed to enlarge the well in the shop for the fitting of a plunger. Such plungers came in oversizes — .002″, .003″, and so on, up to about .010″, with .015″ considered an extremely big plunger.

Those reamers were inadequate, I found, for three reasons: 1, they did not have a guide that would do the job; 2, they required experience not possessed by anyone outside of a machine shop; and 3, they were not the right type and not heavy enough. They would hardly do more than scrape off the dross. If you set them to dig deep enough to cut, they were not heavy enough and would chatter, and the hole would no longer be round but polygonal. (I go into this history because there is still very little sound information on this matter over the country, and in order to show the proper way to ream a well, it is necessary, I have learned from experience, to show the m-o why the other way will not do the job.)

Presently I was rebuilding machines for sale. Through the generosity of George Curle I borrowed one of those light reamers from the *Minneapolis Tribune,* but found it did not satisfy my requirements. The C. H. Edlund Co., where I worked, had about a dozen discarded crucibles on which I could experiment, and with the advice of George Peterson, an experienced machine shop man, I ordered an adjustable reamer for the then fantastic price of $42, and George made a guide for me. I started to work on the old pots, and soon discovered that I did indeed have a sound approach. Refinements followed.

Things I discovered: a new crucible is bored at 2.000″, and a new plunger is 1.998″. After ten or fifteen years the well is worn elliptical, sometimes wider at the front and back, occasionally at the sides, always much more at the bottom. The plunger does not wear as much, but usually most at the bottom. If the plunger is .005″ undersize at the bottom, the well will be at least .025″ oversize at the bottom, while the top of the well will be only .002″ to .003″ oversize. This undoubtedly is the origin of the .002″ oversize plunger. A few years ago machinists would get such a plunger and "grind it in" with emery powder — but the true fact is that very few wells that give trouble can be made parallel under 2.035″. Many have to go .050″ oversize. I confirmed all these facts by measurements with inside mikes and tests with plugs and prussian blue.

(Incidentally, a plunger will expand from .005″ to .006″ when heated to casting temperature).

I selected 2.0625″ as a standard oversize, because it was large enough to cover any well, and because I finally had to buy a second solid reamer for a finish reamer, and this was available size 2 1/16″. I ordered a dozen plungers size 2.060″, and went out into the field and began to rebuild pots on the machines.

For some years I think I had the only adequate reaming equipment in the country for field work, but now Bill Gordon in Minneapolis has done the same thing. His reaming equipment is perhaps not quite as efficient as mine, but his guide is better. And no doubt there are others over the country by now.

Since that first experiment I have reamed upward of a hundred wells, and have come to these conclusions:

As good a job as a factory boring job can and should be done by a skilled man with the proper equipment – but it is not a job for an inexperienced man with *any* kind of equipment. Any machine-shop man will tell you that reamers are the hardest tools in the shop to use.

When properly done, this job is satisfactory in every way. The bigger plunger seems to give a slightly better capacity for a good face. It must be drilled in the bottom to get a proper stroke as explained before. The mouthpiece must be in good condition as outlined in Chapter XIX *Mouthpiece and Lockup,* page 173. (With all these factors in good shape, I have done some experimenting toward casting display faces, and have secured astonishing results on gothic bold type as big as 36-point.)

If an itinerant machinist comes through your town and wants to do a fast hit-and-run job, be sure of these items:

Any manner of installing a plunger a few thousandths oversize is not worth the time spent on it. The plunger should be at least .040″ oversize. This practically eliminates light reamers, because as a rule a light reamer will not go that deep without trouble.

It takes two different reamers to get a round hole; otherwise your hole will be hexagonal or octagonal and .005″ or .006″ larger than it should be.

The reamers for this work should be massive. The shafts at the very least should be 1″ in diameter, and the construction of the reamer itself as heavy as can be gotten into the space available. If there is any doubt, take the proffered oversize plunger to your garage and get it miked. A .005″ oversize plunger could easily be marked .060″ oversize.

A strong and firm guide, attached to the pot itself, is necessary. Otherwise you will wind up with a hole more egg-shaped than before.

A reaming job should always be accompanied by the installation of a new mouthpiece and a thorough adjustment of lockup and all parts connected with the pot. Be sure the pot spring and the plunger spring are in good shape.

What to Do About a Plunger That Is Too Big

This occasionally follows a pot-reaming job, but not very often. (Cast iron is not consistent in its expansion.) If the plunger is tight, first try emery cloth on it, all the way around, a couple of times. If the plunger is still tight – generally evidenced by coming out hard even though you clean it every day; sometimes by sticking during the day – put the rod in a vise, with the plunger snug against the vise-jaws. Take a 10″ or 12″ mill bastard file and go around the plunger with a crowning or rounding motion. You can cover an arc of about ½″ at a time, top to bottom of the plunger, then move to the next section. It is fairly easy to take off .002″ this way, and you don't want more than that, so go easy. You can tell where you have filed by the different appearance of the surface.

Metal Conversion in Customer's Plant

QUESTION: We wish you would give us the formula for converting stereo metal into Linotype metal. A man and his wife came through here on two different occasions and made a lot of this metal and it was okay, but we did not get their formula. It seemed to be a very simple matter. They just skimmed off the foreign matter and put a certain amount of the solution to each pot of metal. – W.H., Humboldt, Tenn.

LOOMIS: Linotype metal is approximately 4% tin, 12% antimony, 84% lead. Stereotype metal is approximately 6% tin, 14% antimony, 80% lead. (Many plants today, however, use the Linotype formula for stereotype and Monotype also.) Antimony makes the alloy harder and requires more tin to fuse the lead and antimony, but this excess lead and antimony is prone to form slag in a Linotype throat and is unsatisfactory to use.

Only refiners with expensive facilities can produce metal with proper content. If tin is required it is easily added in the plant, but if copper, zinc, arsenic, or other elements that encourage slagging, are present, you cannot get them out.

Foundry type contains too much copper for linecasting machines; zinc cuts are bad contaminators.

Tin vaporizes when hot, and is always skimmed off with the dross, and must be replaced to maintain about 3½% to 4%.

Dirt in metal creates a brittle, non-adhesive tendency sometimes along the slug face. Clean metal is important.

Periodic analysis warns you before your metal loses too much tin. The analysis is free, and the metal companies have a "plus plan" to keep your metal up to par.

HARDING: Zinc, copper, arsenic, iron, brass, and aluminum especially should be kept from the metal pot. Such materials can easily get into metal in the chips from a saw.

Tin is the most costly ingredient; it adds body, toughness, and fluidity, and produces a sharp face. Antimony imparts hardness and adds fluidity; it also expands at the point of solidification, though it shrinks as it cools.

Metal contaminated with zinc will leave a cloudy appearance on the surface of skimmed metal. It can be partly removed by shutting off the heat and skimming as the metal starts to solidify. Clean metal has a cobwebby appearance after skimming. Excess antimony will form hard dross in the throat.

Send ten ounces of metal to one of the big companies and tell them how much metal is in your plant. They will give you an estimate on toning metal.

How to Determine Impurities in Metal

QUESTION: How do you determine when metal contains too many impurities? — B.G.E., Eufaula, Ala.

By GEORGE ORTLEB in *The Printing Industry:* After stirring and skimming, good metal should be perfectly clear on top and gradually assume a cobwebby look. If it does not do this, you probably have appreciable contamination. If it looks vivid purple, dark blue, or reddish at 600°, one of the impurities will be zinc, which, even in small amounts, makes type metal "mushy" and unsuitable for use.

Flux

QUESTION: What kind of flux do you recommend?

HARRY G. POTTLE in *The Printing Industry:* Easy use of so-called metal fluxes is dubious. So are home methods of removing impurities from metal. The old-time method of throwing a piece of tallow into the pot seems to help, but this may leave oil in the metal, which may reach the mats. Try another old-timer; put a big Irish potato on the end of a steel rod and stick it down in the bottom. It will bubble and agitate the metal, helping to clean it mechanically. It is doubtful that anyone but a metallurgist can properly use any agent that causes a *chemical* change in the metal. The Monomelt method of using a paddle to rub out the dross seems as good as any.

Pigging Metal is Important

Metal does not undergo as much deterioration in the linecasting machine pot as it does in the remelting furnace, where the temperature is allowed to go pretty high. Use a smelter that will hold 500 to 1000 pounds. Cover it. Don't melt too rapidly. Take 1½ hours to bring 1,000 pounds of metal to 600-650° F. Use a thermometer. Agitate the metal, stirring from the bottom of the pot, and scrape the pot. The oldtimers stuck a potato on the end of a steel rod and stuck it in the metal for agitation, as noted above.

Flux can be used. Tallow has been used and is efficient, but may leave oil in the metal to get on the mats. When the metal reaches the right temperature, stir, flux, separate the dross to a black powder. Skim the metal. Use a dished skimmer at least 4″ in diameter with ¼″ perforations. Put the black powder in a drum that your metal house will furnish without charge. A 500-pound drum of dross and a sample of your metal will bring you 250 pounds of "plus" metal properly compounded. (In sending samples, the trimmings from under the machine are good.)

After skimming, reduce heat and pour as rapidly as possible.

It is common sense to avoid breathing the dust, although actual cases of lead poisoning are very few.

IMPERIAL TYPE METAL COMPANY (in the booklet, *Type Metal Alloys*):

DO NOT: overheat your metal; allow zinc, brass or copper to get into it; attempt toning without analysis; agitate metal unnecessarily; melt less than capacity of pot.

DO: skim metal at proper temperature; use flux; have analysis made periodically; stir molten metal thoroughly; use thermometer; add plus metal regularly.

Which Is the Best Metal?

LOOMIS: It is significant that questions about metal ranked second in frequency to questions about proper speed of an operator, back in the nineties.

In 1899 a reader of *The Inland Printer* asked: "Which is the best metal?" Metal formulas at that time ranged from 70% lead, 10% tin, and 14% antimony, to 100 pounds lead, 8 pounds tin, and 12 pounds antimony, and the price ranged up to 6 cents a pound, according to the formula (lead being far the cheapest ingredient).

"Expert" prudently refrained from sticking his neck out, and in June, 1899, thoughtfully remarked: "It is our opinion that the composition of linotype metal is not as thoroughly understood as it should be." A little later John S. Thompson said, "Poor metal doesn't plug up holes" (presumably mouthpiece holes).

This is by way of noting that there always has been disagreement about linecasting metal, and, as far as I am concerned, there still is. I am about to stick my neck out.

I have long been extremely dubious about the customary beliefs in the all-importance of metal. At one time or another almost every machinist has said that a casting trouble on a certain machine was due to poor metal, and has gone through the process of sending in samples for analysis, and so on. But as I look back over thirty years of repairing machines — and believe me, many of them have been in small plants far from even a railroad, where they never heard of "keeping up" the metal and where anything from tobacco to old shoes has gone into it – in these thirty years I have never worked on a machine in which I could definitely pin the trouble on metal.

This was brought home to me graphically in a two-machine plant in South Dakota. The machines were old and run down, and, from a machinist's standpoint, conditions were atrocious. This applied to the handling of the metal also. The strange part was that they had every kind of trouble but casting trouble. I assumed that by some miracle their metal had maintained its theoretical proportions, though I could not see how. Nevertheless, the slug was solid and the face was good enough for anything in the line of ordinary printing. As a matter of routine, however, I sent off a sample for analysis. About two weeks later the manufacturer sent me a copy of the report. The tin content was down to 2.15%!

I did a lot of careful thinking over that – and since that time I have never told a man, "The trouble must be with your metal." And strangely enough, I have not, as far as I know, left any unsolved casting problems behind me.

This is not to deprecate the conventional views or the exhaustive efforts of the big metal companies to find out more about metal, for they have spent a great deal of money to improve it. But the truth is that they themselves freely say that the composition of metal, or its exact proportion of tin and lead and antimony, is not the whole answer. I know that Imperial for one has made expensive crystallographic and spectrographic studies of linotype metal (and I imagine Federal and many others have too), and they are sincerely trying to get to the bottom of the problem. Imperial, for instance, went to great expense to make a large batch of chemically pure metal, only to find out it would not work in linecasting machines. They discovered that although arsenic above a certain very small percentage caused trouble, no arsenic at all caused more trouble! The only definite conclusion I can see is that linecasting metal, like a great many other scientific and industrial problems, is still a question.

Nevertheless, this does not mean that I throw the metal-care principles out of the window. It merely means that I have not, for many years, said, "It must be the fault of your metal." I have always, so far, been able to find some other reason for casting trouble.

I firmly urge – and practice – common sense principles in the care of metal. Don't contaminate it. Remelt properly, without getting above 650° F. Use some plus metal if the manufacturer recommends it, but if you have real casting trouble, don't expect a batch of new metal to fix it.

LINECASTING OPERATOR-MACHINIST

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