HAND-SWAGED BULLETS AT HOME

J. C. Braconi

I first got interested in making my own bullets in the mid 1980's. A 1962 **Rifle** article written by Frank Beard, and several others by **Precision Shooting** columnist William Purcell (March, April, & June 1981) piqued my interest. It was shortly after that I contacted Clarence Detsch and ordered two sets of carbide dies, one in .22 caliber and the other in 6mm.

As my experience with die and bulletmaking is limited to Detsch Dies and producing hollow-pointed, flat-based benchrest bullets, I will limit my comments to this specific area.

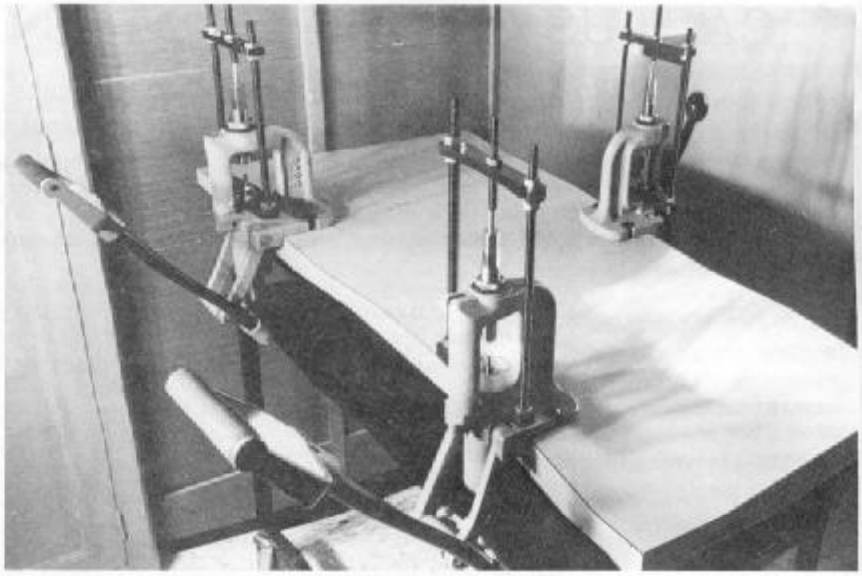

Photo #2

WORK ENVIRONMENT

The first thing I learned was that you must find your self a suitable work environment, some place out of the way of "family traffic patterns" and distractions. The area must also be free of dirt and grit. Regulating the work area temperature between 64 and 72 degree is also a plus. Temperature plays a very important role in the forming of metals with lubricants. Once set up, you will not want to disassemble the equipment and start fresh each time you need to make some bullets. If you leave the equipment set up, be sure to keep an eye out for the curious passerby; most can not resist the temptation of touching something.

DIES AND PRESSES

The first thing you need to get is a set of quality-made dies in the desired caliber. (See photo 1).

The next is 1, or even better, 3 solid "O" ring design presses. The RCBS "Rockchucker Combo" with a unique custom-fitted ram and an auto-ejector frame will get the job done very nicely.

One of the most critical secondary pieces of equipment is a properly sized work bench. It must, and I emphasize must, be comfortable. It should be designed in such a manner that it will afford you maximum comfort while work is in progress. When seated, your shoulders should be no less than 10 or so inches above the top of the bench. It is of maximum importance that you are comfortable in all the operations of bulletmaking. Fatigue will certainly affect your final product.

I have found that the addition of a "Big Max" handle to the press has a positive impact on reducing arm fatigue. (See photo 2).

Another improvement I have incorporated is the addition of a link stop which limits the amount of twist inherent in off-set arm presses. (See photo 3).

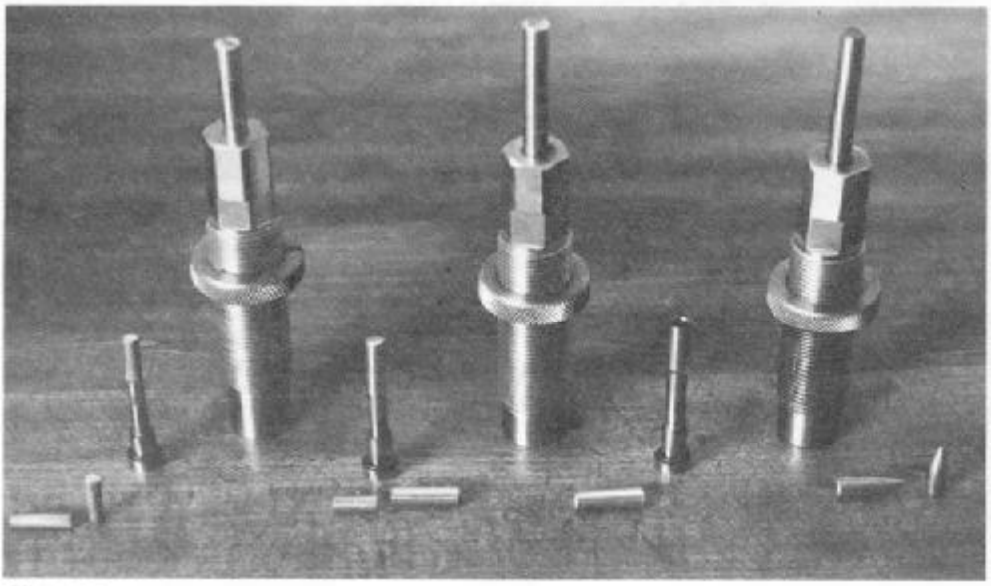

Photo #1

CLEANING

Before addressing bullet component supplies, I thought I'd tell you a little about degreasing agents, lubes, etc.

For degreasing I use Trichlorethylene. It is fast acting and leaves no harmful residue. You must be careful though to only use it in a well ventilated area. The fumes are toxic and quite harmful.

5 jars of chemical are required for material cleaning operations. The first jar is used for cleaning jackets. The second and third are for a two step core cleaning operation, and jars four and five are for cleaning the final product - completely formed bullets. (See photo 4).

Another thing that comes in handy is a drying tray. Mine is bored stainless assembled with stainless screws. You need a lot of paper towels in the air drying operation, at least four per tray.

The jars should hold approximately a half gallon of liquid. This is enough for cleaning 1000 components. I use several types of jar lids in cleaning operations. Where draining is necessary and damage could occur to components, I perforate the lids from the in-

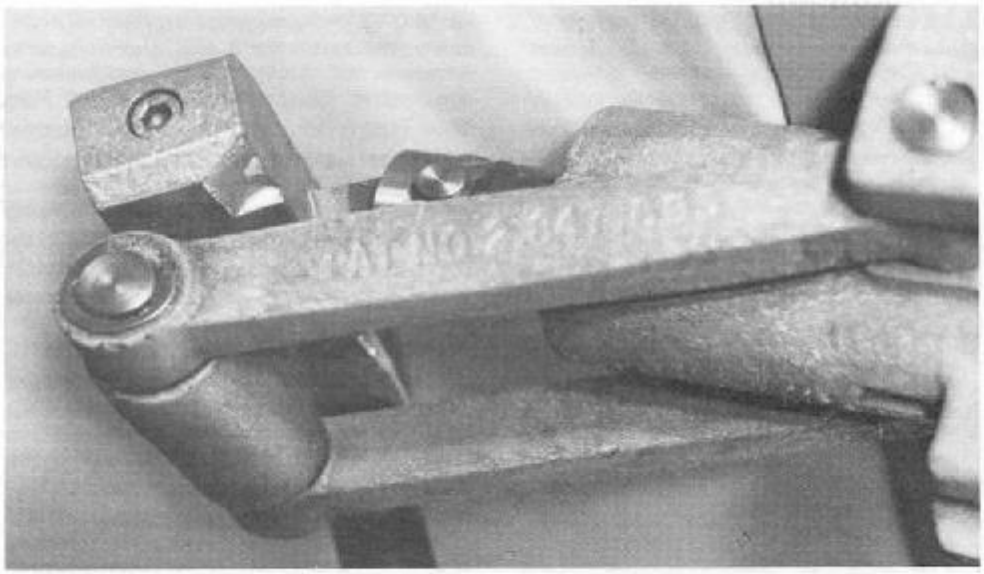

Photo #3

side out. This leaves burrs on the outside of the vessel and prevents damage to jackets and cores.

I use wide-mouthed jars for the lubrication of jackets. I fit each lubricating jar with a 100% cotton sleeve. I sew two pieces of material together and line the inside of the jar with the fabricated sleeve. The cotton material sleeve is held in place with the spring of an old alarm clock. (You may have to find another method of holding the sleeve in place if you do not have a broken alarm clock around the house.)

Lead cores are lubricated in a much smaller jar, approximately one pint. I don't think it is wise to lube 1000 cores at one time in a single jar, too much deformation damage occurs. When you are using lubes and not solvents, plastic jar lids are fine. For long term storage of components you will need several moderately sized containers. I have my wife believing Tupperware was made for this purpose.

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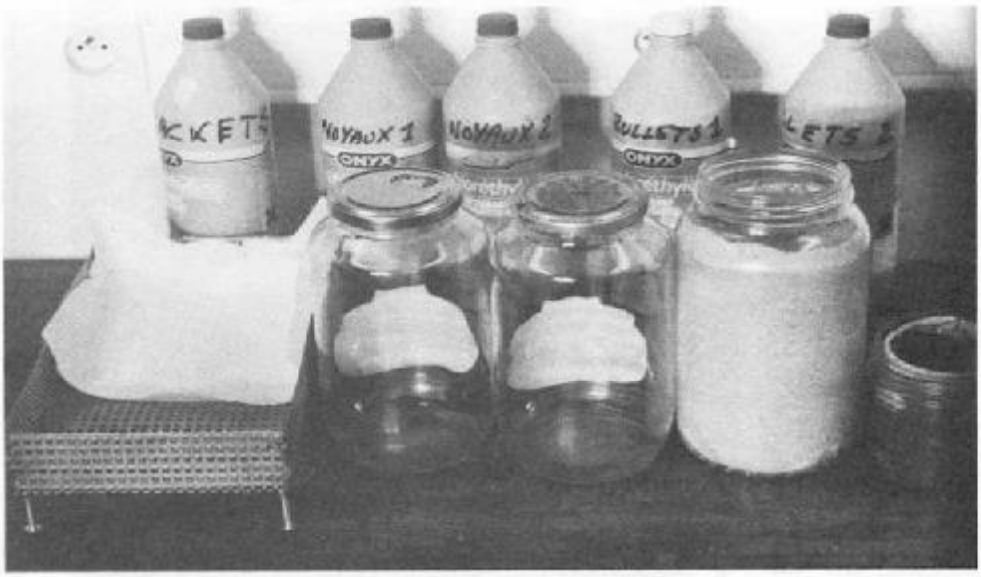

Photo #4

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JACKETS AND CORES

As most of you know, bullets are made from copper jackets and lead wire cut to length, more commonly referred to as cores. I have used J-4 Jackets exclusively over the years and have found them to be quite good with respect to quality. The primary distributor for J-4 is Walt Berger in Phoenix, AZ. Sierra Bullets also makes a fine jacket. They can be purchased from R.W. Hart & Son of Nescopeck, PA. Both of these companies advertise in Precision Shooting.

In France, obtaining quality lead wire is no easy task, but I have recently found a foundry manager who is quite interested in shooting. Needless to say, I now get my lead wire in rolls. I have found that I can use one diameter of lead wire to make both .22 and 6mm bullets. 4.5mm (.177") diameter does just fine. Pure lead is what you want to use. Never use lead with tin or antimony to make bullets. It is too hard and can cause permanent damage to your dies, to say nothing of degrading accuracy.

The core cutter pictured in photo 5 shows how the lead is cut to length. These lengths, prior to forming are called slugs. The length of the slug is determined by the desired weight of the bullet. The core cutting tool is easily adjusted by turning an adjustable stop. I draw the spooled lead wire into the cutting tool from an axle made from a large screwdriver clamped in a vise. As you can see into the photo an aluminum "V" is used to guide the wire into the cutter blade. I

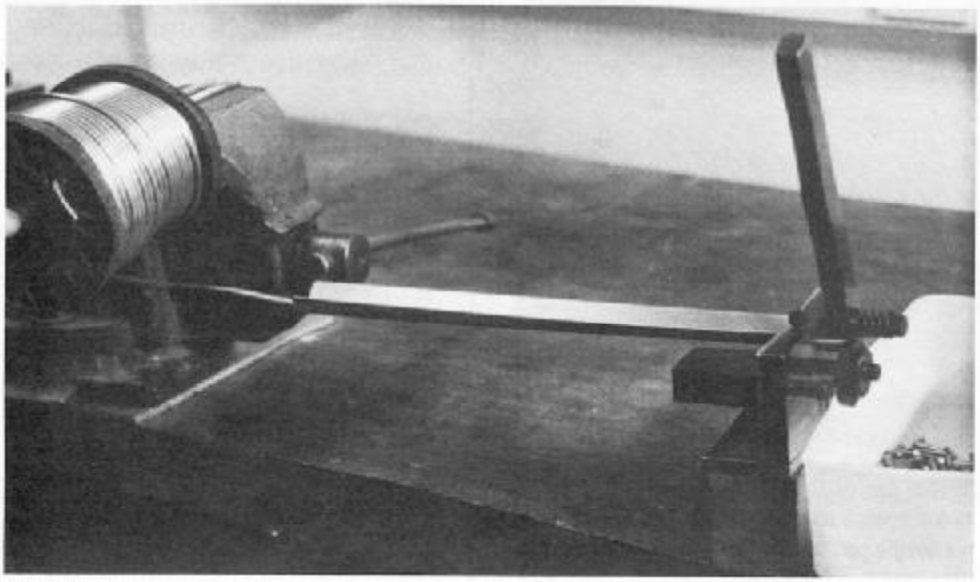

Photo #5

Photo #6

Photo #7

straighten the wire out by pressing it into the "V" with my thumb. This method is quite effective. The inside angle of the aluminum "V" has a radius that conforms to the diameter of the wire.

The slugs should be cut to a length that causes them to weigh slightly more than the desired finish weight. Approximately 2 1/2 grains for .22 caliber bullets and 3 grains for 6mm. The excess material is "bled-off" in the core form die.

The first jar (photo 6) shows the lead slug cleaning process. I usually cut 1000 slugs at a time and clean them. Removing all grease and grime is critical to the task of making quality bullets. Its importance can not be overstated. I take the first jar and fill it half full with the degreasing agent. This, as mentioned earlier, accommodates approximately 1000 slugs. You then add the slugs to the jar and fill the rest of the jar with the degreasing solution. Put the lid on the jar, and gently roll the container by hand at approximately a 30 degree angle for a minute or so.

The next thing you do is change the plain lid to one that has been perforated from the inside. When pouring the fluid from the jar, be sure to filter the liquid with paper towel to remove small pieces of lead and foreign particulate before putting the solution back into its original container. (See photo 7). You then unscrew the lid and gently shake the lead slugs into a drying tray lined with paper toweling and cover with same. When cleaned properly, slugs have a tendency to hold lubricant more uniformly.

LUBRICANTS

I use one lubricant for cores and jackets. It is made by mixing 2/3 lanolin with 1/3 Vaseline, by weight. The two materials are joined in a double boiler on top of the stove. I stir the mixture with a clean spoon until it gets to a "honey-like" consistency. Lanolin, as you know comes from sheep and Vaseline is a mineral product. They happen to

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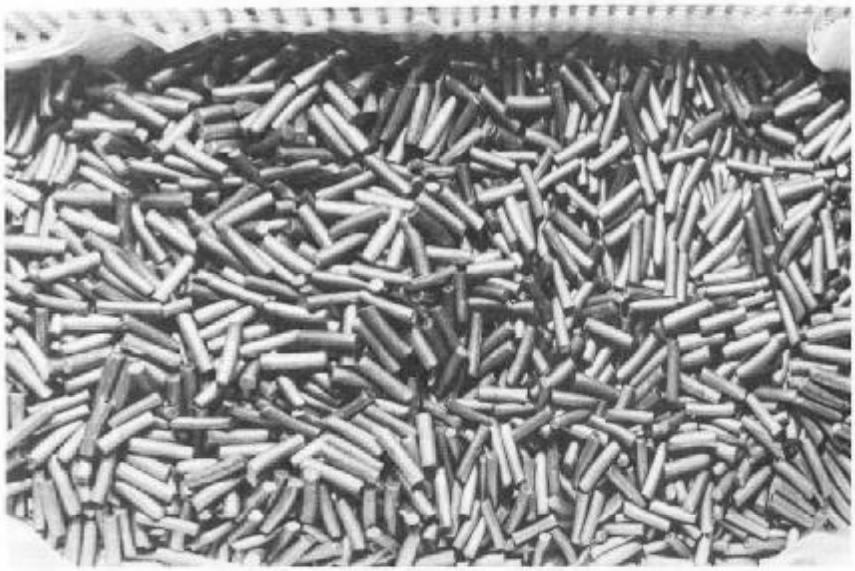

Photo #8

Photo #9

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Continued

mix well together. You can probably purchase both products from your local drug store.

Use rubber gloves when saturating the cotton sleeves with lubricant. Be sure to wring the cotton sleeves out before lining the inside of the jar with them. Too much lube is as harmful as too little. It is important to get the sleeves fitted inside the jars before the lube gets too pasty.

Because the slugs weigh much more than the jackets, use a smaller jar to lubricate them. 200 slugs at a time is more than enough, and will not cause damage in the process. As in the degreasing process, gently roll the slugs in the jar at about a 30 degree angle for one minute. Repeat this step until all 1000 slugs have been lubed uniformly. Once this is accomplished store them in an air tight container. (See photo 9).

FORMING CORES

Forming cores is one of my least liked chores, but it is one of the most important in the process. Varying core weights cause difficulties in the seating and pointing steps as well as uniformity in the end product. When forming cores it is very important that you develop a smooth, steady, and uniform rhythm.

You begin the forming operation by screwing the form die into the top of the press, being certain you have a properly sized punch in the ram. Sliding a neoprene "o" ring over the punch will cause the lock nut to hold the punch in place and prevent metal to metal contact. (See photo 1). This allows proper alignment and restricts punch movement in the ram. A misaligned punch can either wear badly or score the inside of the die, rendering it useless.

When you purchase a new set of dies, most are shipped with some kind of oil or rust inhibitor on them. I have found it better to work the lubricant out of the dies than it is to use some kind of degreasing agent on them.

To adjust the die, put a lubricated slug in the die and slowly lower the press arm until it bottoms out. Be certain that the punch is not binding in any way. You then screw the die down into the press until you feel the knockout punch in the die meet the core. You now slightly lower the ram and give the die an additional half turn. You're almost in business. (See photo 10).

Run several cores to get your motion and rhythm going. It is also advisable to gather a few formed cores up and check them for uniform weight. Weigh one with a jacket and be certain you have met your design criteria. At this point you may have to make minor adjustments to your die position. Screw the die down if lighter cores are desired, up for heavier ones.

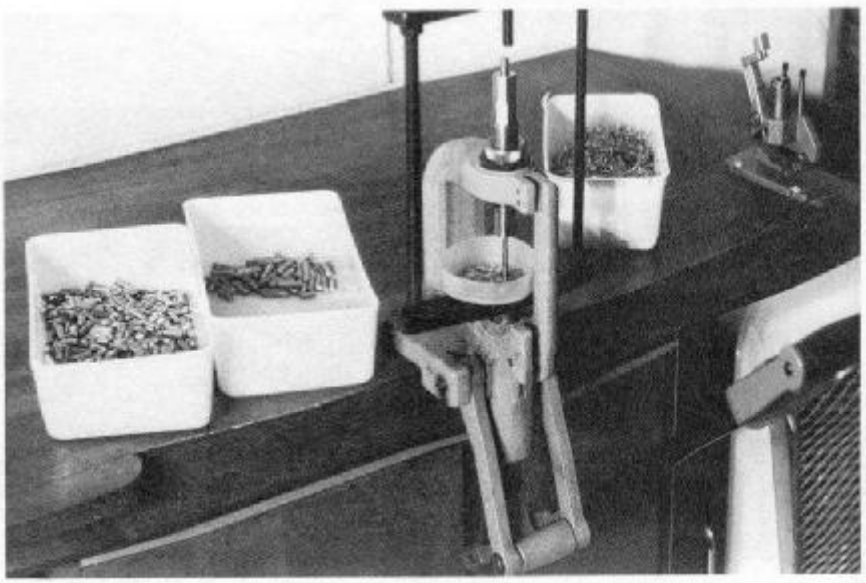

Photo #10

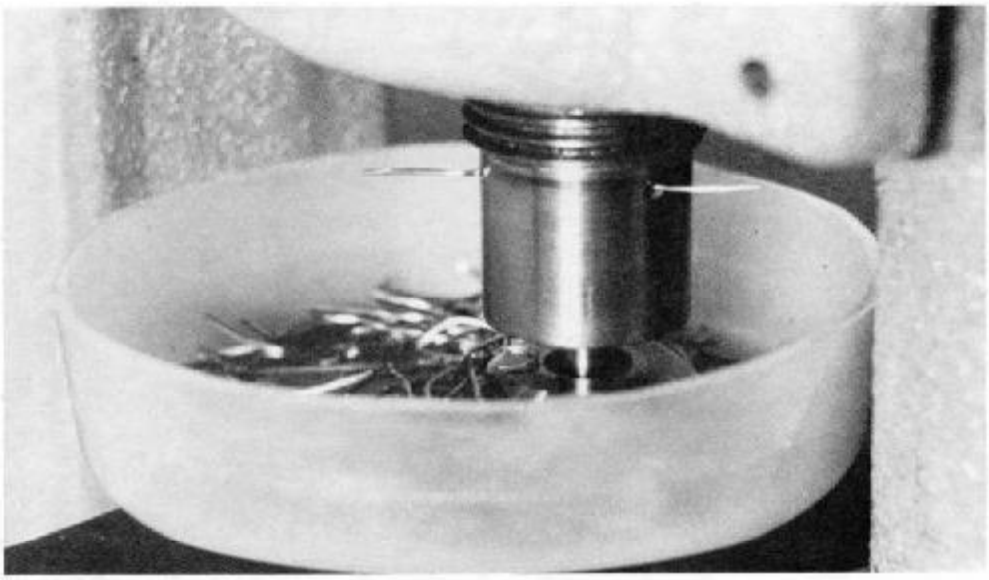

Photo #11

It is important that each time you adjust your dies that you remember to also loosen your punch lock nut. Tighten it up again while it is in the die.

During the forming operation you can see lead squirting out of the die's bleed holes. (See photo 11). The average length of the bled-by lead is 1/2" for .22's and less than 3/4" for 6mm. Do not be alarmed if after having reached the top if lead continues to flow out of the die. This is to be expected.

Experience tells me that double pumping the press arm is the best method of achieving weight uniformity in this operation. By double pumping I mean, press the arm down until it stops, than release all downward pressure for a moment and then restore downward pressure. You will see that the lead stops bleeding for a moment and then resumes when you apply new pressure. This is caused by spring in the frame of the press. The sturdiest presses available all do this. It is nothing to be concerned with. Photo 10 shows from left to right, extruded cores, lubricated slugs, and a tray of lead squirts.

Photo 11 shows the small tray being used to collect the lead squirts. This is a good idea. You don't want the lead laying all over your work area floor.

If you feel something unusual in the core forming operation, i.e., too light or soft a stroke, it is probably due to non-uniform lubrication or slug length. I shouldn't have to tell you not to use these cores. Throw them away.

If you have measured success in this operation you have the right to be proud of yourself. This is a very difficult thing to get right the first time.

As mentioned earlier, you must store your formed cores in a sealed container to prevent them from oxidizing. It is also wise not to mix cores made on one day with those of another. You can be sure they will not be identical. This is why I work in lots of 1000, completing each of the three operations on consecutive days.

Lead and copper are not inert, they need to be stressed relieved after being worked. It is advisable to let them sit for 24 hours or so before subjecting them to the next process.

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CORE SEATING

Prior to seating the cores, they need to be degreased and lubricated. As with the slugs, the newly formed cores need to be clean. Two degreasing baths are required. Rotate the jar full of cores very carefully. They are extremely susceptible to damage in this step. Remember to filter each bath. (See photo 12).

Core drying is accomplished in the same manner as previously described, in a drying tray lined with paper towel. After cleaning, cores should be bright and shiny.

The next step is to clean the copper jackets. It won't take you long to get into the cleaning mode. Cleaning is cleaning no matter what the material. Follow the previously described routine. It won't take you long to develop your own quality improving methods. One bath is generally good enough for the jackets unless they are unusually dirty. (See photo 14).

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Photo #13

Photo #12

Photo #14

Photo #15

Photo #16

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After you have filtered the degreasing agent and returned it to its original container, let the filter dry out. If you hold it up to the light you will see the value of filtration. The paper filter picks up a lot of material. Believe me you would not want this stuff in your new dies.

The tube like jackets are very hard to dry because of their shape. The way I dry them is to place them in a clean white sack and hang them in a sun light window. Air drying seems to be the best method. It takes awhile, but it is quite effective. You may be wondering why I specified a white sack. It's simple, really. It is easy tell when the sack needs to be cleaned. You want it to be as clean as possible. Every so often I take the bag by its corners and give it a shake just to move the jackets around inside. It makes things go a little faster. The jackets are dry when the bag is dry! What could be simpler than that? (see Photo 15).

The dried jackets are now carefully poured into one of the lubricating jars. (See photo 16).

The amount of time the jackets must be rotated in the jar can only be determined by the amount of lube on the cloth inside the jar. With experience you will be able to feel the cloth inside the jar and determine what

Photo #17

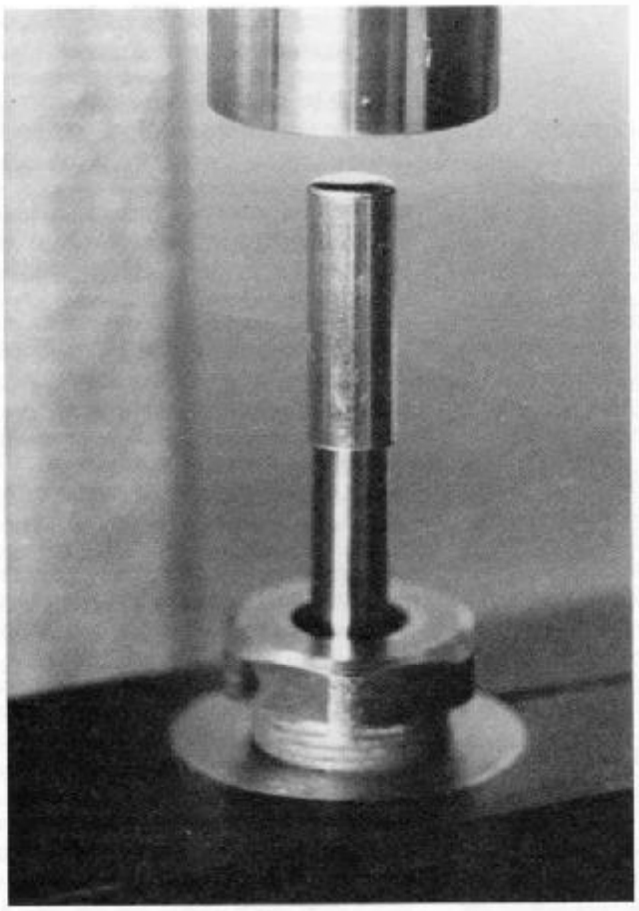

Photo #18

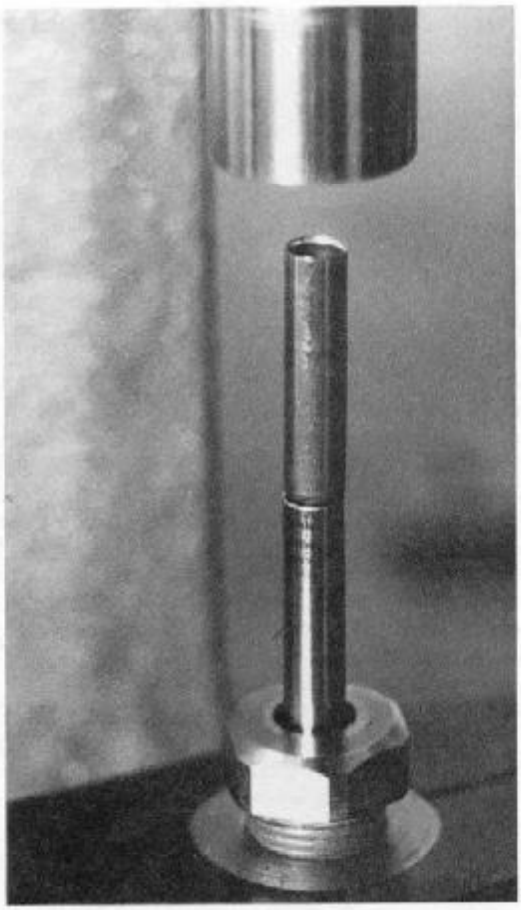

Photo #19

that time might be. If you have too much lube inside the jar, you can remedy the situation by rolling clean steel cylinders or balls around inside. Remove them several times, and wipe them down with paper towel until the inside of the lube jar is just right. If the lube has settled to the bottom of the jar, you can run the jar under hot water to melt it and get it flowing again. Be certain not to get any water inside the jar. Keep the lid tightly closed.

The lube pad inside the jar should feel like a new piece of soap. It won't take you long to develop a feel for this operation. Once again, store the lubed jackets in a clean, sealable container.

In photograph 17 you will see the components necessary to make the final product. Just to the left of the press are the lubed jackets. On the right of the press are my cleaned cores. On the far left, are core seated jackets ready for pointing. I find this work configuration quite handy. I pick up one component in each hand and very carefully put one into the other.

The core seating die is adjusted just like the core forming die. Screw it into the press and be certain that the correct punch has been selected and is seated in the ram prop-

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erly. Photo 18 shows a core stuffed jacket upside-down on the punch. What you do next is raise the ram to the top of its stroke, let the punch float, and then tighten it down. Now, screw the die down until you feel resistance from the jacket touching the knock-out pin. Lower the ram a few inches and screw the die down approximately 1/4 turn more.

Raising the ram will start the expansion of the lead in the jacket. The purpose of this operation is to expand the core to fill the jacket to capacity without stressing the die. The proper pressure to use for seating the core and expanding the jacket is the amount required to do the job and leave it inside the die. The core filled jacket should not follow the punch out of the die on the down stroke of the ram. Adjust the die down approximately 1/16th of a turn until the jacket sticks in the die and can be easily pushed out with finger pressure on the knockout pin.

If the jacket core is hard to eject by hand that means you did not do a good enough job of lubricating them. Return the batch of jackets to that operation and start over.

If you feel that you cannot put any more pressure on the ram without breaking something or the core always follows the punch out, you must check two things. First, check to see that you are using the right diameter punch, a larger one could scratch or gouge the inside of the copper jacket and cause it to stick. You can also, as the punch advances, break the jacket at the lead line. When this happens, a loud crack can be heard. It sounds so bad at times that you wonder whether you have cracked your die. This can and does happen, believe me. The second thing you need to check is jacket lubrication. You may have gotten too much lube on the jackets.

If you cannot pull the stuck jacket off the punch without resorting to carefully applied tools, you have got your first serious problem. Usually though, wiping the jacket off with dry fingers and pushing it up into the die for 15 seconds or so will do the job.

The interior taper of jackets, coupled with wall thickness variations found in different lots can cause serious problems. This is why it is advisable to order, from your diemaker, several additional punches. Purchase them in graduations of .0005" to be sure you have covered all possibilities.

The correct punch is one that is large enough to prevent a fin of lead from squirting past the punch and small enough to not score or gouge the interior of the jacket.

Like core forming, if you feel a lot of variation in the pressure required to seat cores, the best thing to do is throw them away. Next time try and pay a little more attention to detail when forming the cores.

Since the seating operation changes the shape of the lead and copper sleeves, I feel that it is wise, once again, to let them "rest." Twenty four hours or so in a closed container will do the job very nicely. Stress relieving is very important in my opinion. These things cannot and should not be rushed.

FINAL FORMING

Now comes the time to form the bullets to their final shape. The finished product will tell whether or not you have been diligent in your efforts.

Having lubed your jackets prior to seating the cores, you don't have to do it again. In fact, the previous step has further caused the lube to be more evenly distributed on the jacket surfaces.

Before putting the point-up die in the press, check to be sure the ejection pin is

not too long. This can be accomplished by looking into the die while pulling the pin toward the top of the die. At the point where the pin is flush with the end of the forming chamber, the inside of the die will light up with a reflection of the light on the tip of the pin. Pulling the pin farther out will make the inside of the die dark again. If while pulling the pin outward, you do not see the chamber light up, the pin is too long and will get caught in the hollowpoint of the bullet upon forming. The ejection pin must not extend into the point forming die at all.

After exchanging the seating punch for the swage punch, finger tighten the lock nut over the "o" ring, so it will align itself with the inside of the die. With the punch raised to its highest position, screw the die in place with a cored jacket on top of the punch until you feel slight resistance. (See photo 19). This is the lip of the jacket touching the beginning of the ogive inside the form die. Lower the ram and screw the die the estimated distance needed into the press, being certain that the punch is in proper alignment. Now you can lower the ram and force the bullet into the point-up die. (See photo 20). If it falls short, the knock out pin will penetrate the bullet point and enter the core. As a result, the bullet will be stuck in the die and will not eject. This is not a time to panic and do something completely irrational. The cure is to unscrew the die, clamp it into a vise and drill a small hole in the base of the bullet. You then can extract the bullet by turning a wood screw into the newly drilled hole. Once this is accomplished, remove the die from the vise and put the head of the screw in its place. Tug on the die until the bullet releases itself from the die.

To avoid scratching the die, you must be careful not to over drill the pilot hole for the wood screw. You should make yourself a small brass center punch to insure proper

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Photo #20

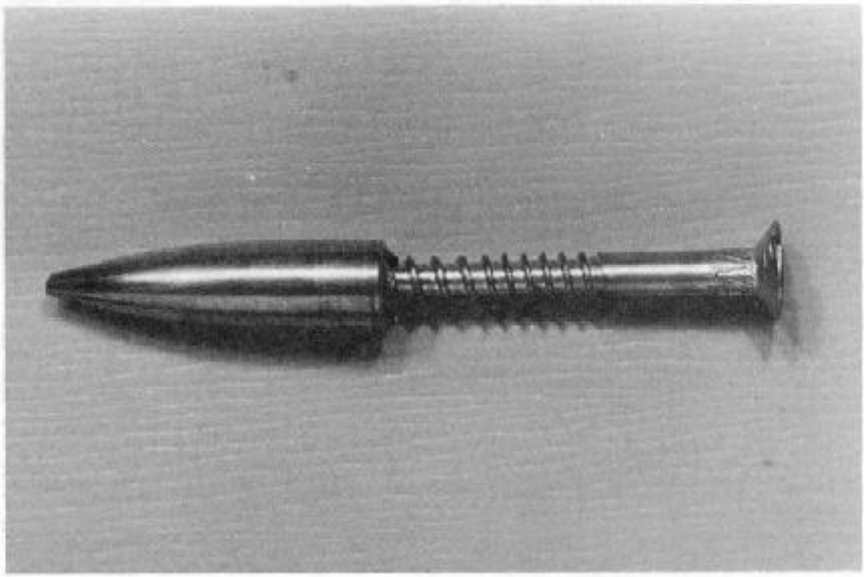

Photo #21

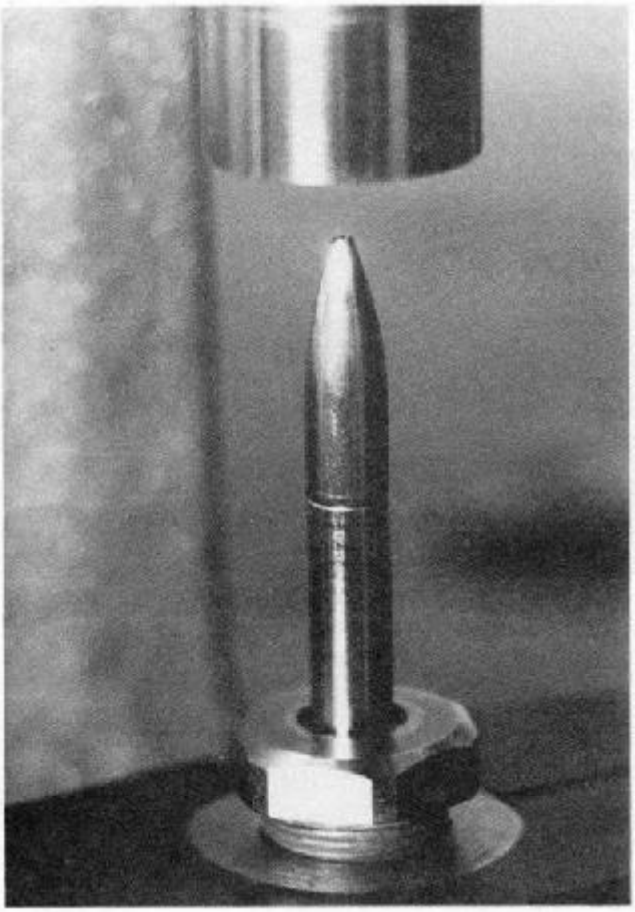

Photo #22

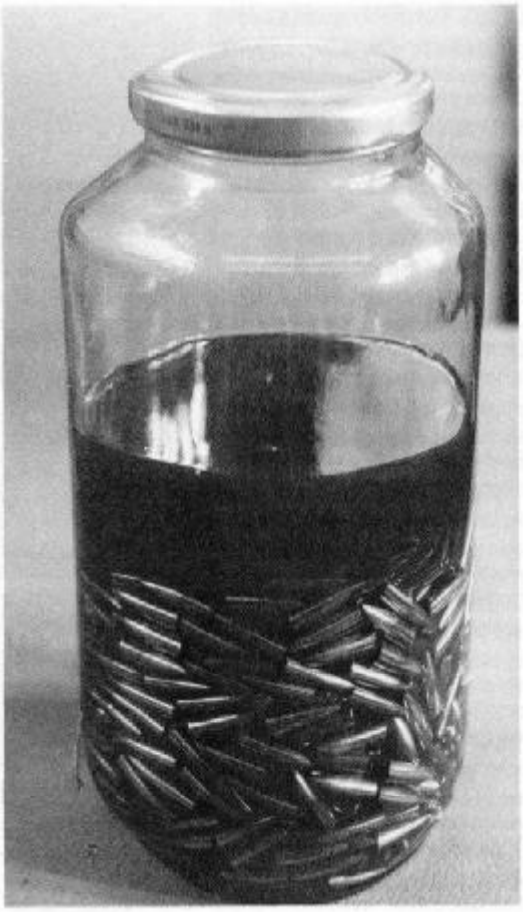

Photo #23

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placement of the drill bit. Do not drill too far into the bullet. Less than 1/8" is sufficient. After making further adjustment the die in the press try the operation again.

Eject the bullet and see whether further adjustments are necessary. Chances are, you will need to make some further refinements. If the point is too large or too small, correct this by raising or lowering the die small amounts. The point should be the same diameter as the ejection pin used and show no evidence of having gone into the pin hole of the die. (See photo 22).

In forming the point of the bullet, the press arm should be actuated smartly. This ensures that each bullet is formed in the same length of time. Bullets formed at different speeds are seldom uniform. They have a tendency to have different dimensional characteristics, similar to those occurring when lubrication is not uniform.

Close inspection of the finished bullet might show longitudinal lines or even wrinkles from the beginning of the ogive to the point. These are not defects. The diameter of the jacket having been severely altered accounts for these lines. Wrinkles occur as a result of excess lubricant, and do not effect accuracy, only the way the bullets look.

The most important part of the bullet is the base. While some bulletmakers feel that it is better to err on the side of using too much lube, I believe you are better to use it sparingly. On the other hand, too little causes the bullets to stick in the die. You need to find a happy medium.

It is my contention that the bullet should as closely replicate the interior dimensions of the form die as possible. If the amount of lubricant is more than the amount necessary to keep the bullet from sticking in the die, it will form a uneven barrier between the jacket and the die. This significantly contributes to irregular ogives, diameters, and pressure ring dimensions.

Bullets of different dimensions are primarily responsible for non-standard performance in target rifles. Different dimensions = different velocities and points of impact. Seating your bullets to just touch the lands of your barrel is impossible if your bullets have irregular ogives.

After you make your first dozen bullets it is wise to stop and take some measurements. If the pressure ring measures about .0002" to .0003" larger than the point just ahead of it and if the ogive grooves previously described are not excessive, you are on the right track.

After final forming, the bullets retain some lubricant. I think this is detrimental to accuracy, so I clean them up. I use the same two bath procedures previously described for core cleaning. (See photos 23 & 24).

Photo 25 is a cutaway view of cored jackets and swaged bullets in .22 caliber and 6mm. I have milled them to check the amount of distortion to the lead in the pointing process. From left to right, numbers 3 and 6 are boattail bullets made by a highly regarded bulletmaker. I find it interesting to note that the 6 mm bullet on the right-hand side of the page is a bit irregular. Notice how the top of the core does not contact the sides of the jacket. If someone can explain how this occurs, I'd be grateful. This bullet is not one of a kind either. I cut a several of them in half and they were all this way. Interesting isn't it?

MEASURING RUNOUT

I have used all kind of measuring devices in my experiments, i.e., mechanical and electronic (Verne Juenke's Electronic Comparitor). Testing demonstrates that runout on a bullet directly relates to non-uniform jackets.

When the bullet is still inside the die it is perfectly round, unless you got your hands on a substandard die. Once outside the die, the compressed lead inside the casing wants to return to is original shape. It stretches the jacket every way it can in order to achieve this. The jacket tries to resist this, but if one side is thinner than another it is subject to this type of deformation. A small release of the wall will result in runout.

We can compare this to a rubber tire inner tube. If we increase pressure, the tire does not deform. The rubber tire does not allow the inner tube to balloon. It contains the tube in much the same way a die contains a bullet. Try increasing pressure to the same tube outside the tire and see what happens. You begin to see bulges developing in the thinner areas of the tubes wall.

Before driving hundreds of miles to attend a match, I check some of the bullets that will be accompanying me on the trip. I look for wall uniformity primarily. I trust my work with respect to weight. They all weigh within 1/10 of a grain of each other (scale tolerance). I must admit I like the Juenke ICC unit for checking wall uniformity.

Bulletmaking is slow tedious work, but it is not something that needs to be hurried. I never look to shave corners or save time in this work. It just never pays off. There is a right way and a wrong way to make bullets. I am always interested in ways to improve quality. The amount of time that it takes to accomplish this is of little consequence to me.

If my presentation has been too detailed or repetitious, I apologize. For those of you that are considering making your own bullets, I hope this article will help you make up your mind.

I'd like to dedicate this article to those shooters that have never been satisfied with things as they were. We need constant experimentation if we are to advance beyond present limitations.

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Photo #24

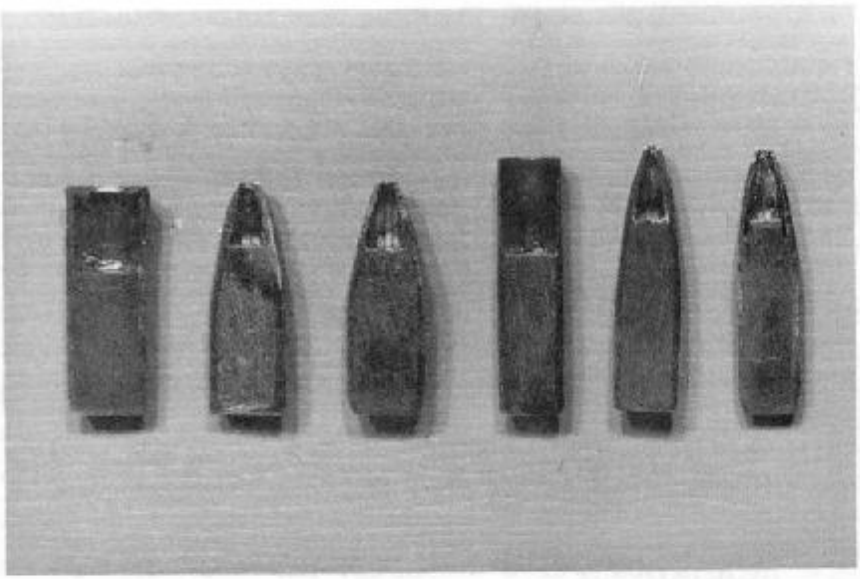

Photo #25