How Dies Are Made

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In order to understand how die varieties such as doubled dies, repunched mint marks (RPMs), over mint marks (OMMs), repunched dates (RPDs), overdates (OVDs), and misplaced dates (MPDs) are produced, we need to have a working knowledge of how the dies which are used to strike coins are made. All of the variety types noted here are die errors. This means that the error is on the die itself.

A **die** is a steel rod with a face that is the same size as the coins that it will be striking. This steel rod will contain the design for one side of the coin. Two of these steel rods (dies) are needed to strike coins. One will have the obverse (front) design and the other will have the reverse (back) design.

The dies are set up in a machine called a **coining press** so that a **planchet** (blank) will come between them. In the older coining presses, one die would be positioned above the other. The upper die (**hammer die**) would come down with great force and strike the planchet while it was resting on the lower die (**anvil die**). The force of the upper die striking the planchet on the lower die would place the images from the dies onto the planchet and the result would be a coin as we know it.

There is often a great deal of misunderstanding by those unfamiliar with die varieties as to how they are produced. Many collectors think that die varieties are produced as the coins are being struck. In the case of doubled dies, a frequent misconception is that they are produced when coins are struck twice by the dies. This is not the case, as we will soon see. Coins made for circulation are struck only once. Only proof coins are struck twice and, even there, that is not the cause of any doubled dies that might be found on proof coins.

The truth is that all die varieties, including doubled dies, are the result of mishaps that occur in the process of making the dies. As we explore the die making process, we will see how the various die varieties resulted over the years. Modern mint technology for the die making process has now removed the likelihood that the die varieties we enjoy collecting will ever be produced again.

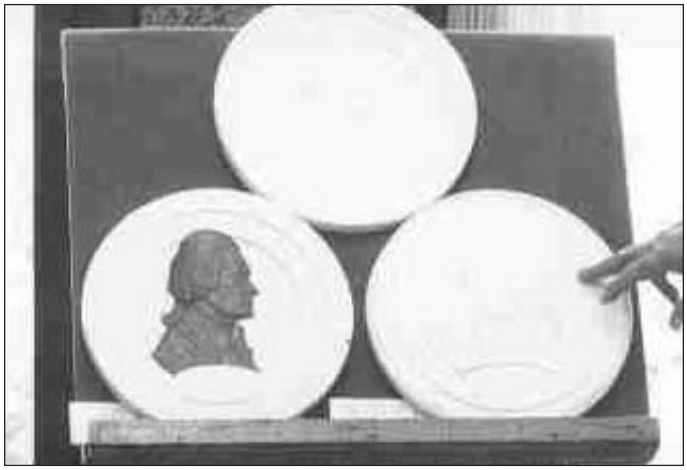
In this installment, we will give you an overview of the die making process. In the months ahead, we will look at each step along the way and we will see the point in the process at which the various types of varieties can occur.

The whole process of making dies traces back to the designing of the image we see on the coins. Once a coin design has been submitted and approved, a mint engraver will make a three-dimensional model in clay. Only the central part of this design appears on this clay model. Plaster is then poured over the clay model. The result is a plaster model with the design **incused** or indented.

Today the lettering that we see around the rim, as well as the full date, are engraved into this plaster negative. Up until the mid-eighties, only the first two digits of the date were engraved into the plaster negative. In the nineteenth century the lettering around the rim was added at a later point in the die making process. Dates and mint marks were also added at different points in the die making process. We will examine all of these factors as we look at the various types of varieties that were produced over the years.

A number of the plaster models are made and worked on so that the best possible model is produced. Today they make a negative rubber mold into which epoxy is poured. The epoxy forms a very durable model which is known as the **galvano**. This process was modified over the years. Earlier galvanos were once made of copper-coated shells which were given a lead backing to make

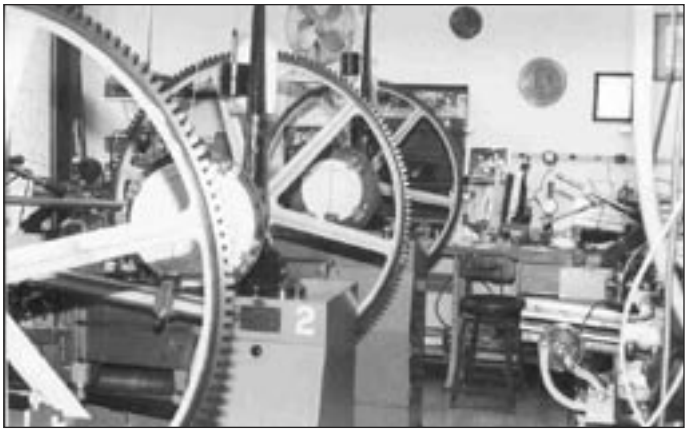
them more durable.



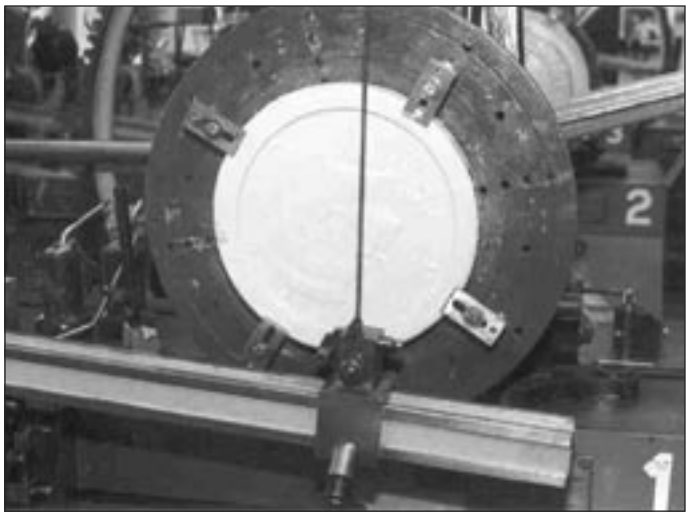
Here we see some finished galvanos. This photo was taken during a trip to the Philadelphia Mint in June of 1998.

Since the galvano is too large, the design must be reduced in size to that which will be used on the dies to strike the coins. This is accomplished by placing the galvano in a machine known as a **Janvier Reduction Lathe**. It is a pantograph with two arms. As one arm traces out the design on the galvano, the other carves it into the face of a steel rod. The face of the steel rod is the exact size of the coins that will be struck with that design.

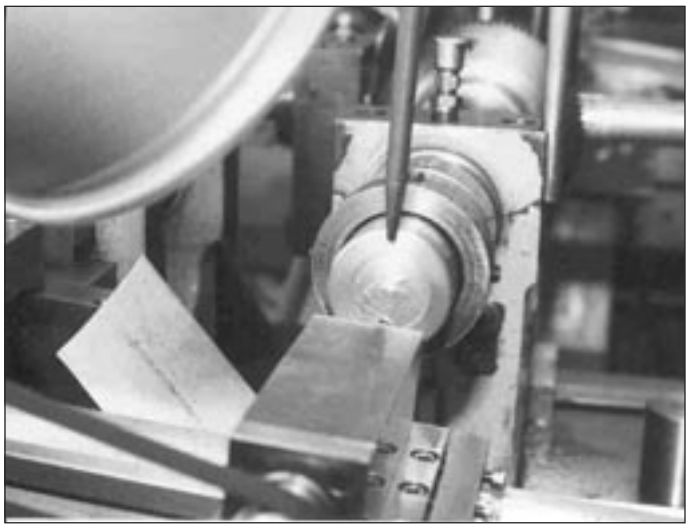
The Janvier Reduction Lathe can transfer the design either in relief (raised) or incuse (depressed) into the face of the steel rod. Despite this, it is almost always transferred so that the result is a relief image. The process of transferring the design from the galvano to the face of the steel rod is a slow and tedious one. It can take anywhere from a day and a half to two days to transfer the design. When completed, the face of the steel rod looks just like a finished coin with that design. This steel rod is known as a **Master Hub**.



In this photo we see several of the Janvier Reduction Lathes in use at the Philadelphia Mint. The round white objects at the centers are the galvanos.



Here we have a close-up of a galvano for the 1999-S proof Kennedy half dollars as it is centered in one of the Janvier Reduction Lathes. Remember that our trip to the Mint was in June of 1998, which should give you an idea of how far in advance they have to begin producing the dies for the following year's coin production.



In the same Janvier Reduction Lathe we see the steel rod that is being transformed into a Master Hub for the 1999-S proof Kennedy half dollars

This finished Master Hub is then used to make a Master Die for that year. The **Master Die** is made by taking the Master Hub and another blank steel rod and placing them in a machine known as a **Hubbing Press**. The arrangement in the hubbing press is much like that in the coin press where the two dies are placed opposite each other. In the hubbing press, the Master Hub is placed directly above a blank steel rod. Several hundred tons of pressure is applied as the Master Hub is squeezed into the face of the blank steel rod. The image from the Master Hub is left in the face of the steel rod but now it is a negative (incused) image.

These are blank steel rods used in the hubbing press to get Master Dies, Working Hubs or Working Dies.

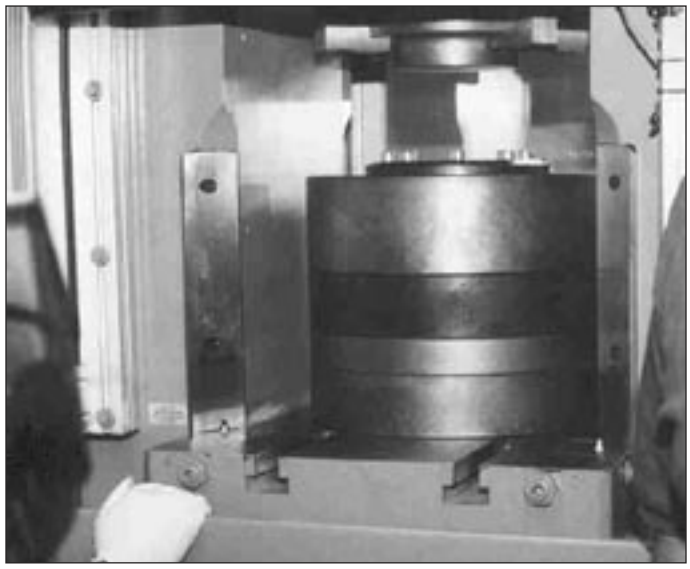
Even though the pressure used to force the Master Hub into the blank steel rod was substantial, prior to 1996 it wasn't enough to leave a satisfactory image in the Master Die. The force of the Master Hub being pushed into the face of the blank steel rod quickly hardened the steel of that rod. If the pressure were continued, the Master Die being created would crack or break before a satisfactory image was imparted.

To get a satisfactory image in the Master Die, it was necessary to remove the Master Die from the hubbing press and heat it to "soften" it. This process was known as **annealing**. The incomplete Master Die was then returned to the hubbing press and another impression (hubbing) would be made to strengthen the design. Sometimes it took four or more of these hubbings to make a satisfactory image in the Master Die.

A major turning point for hub and die production in the U.S. Mints came in the summer of 1995 when the Denver Mint opened its own die making shop. Here a new type of hubbing press was introduced. These new hubbing presses allowed for completed hubs and dies to be produced with just a **single "squeeze"** or **hubbing**. Hubs and dies no longer needed to be annealed for additional impressions.

The process was used for the production of cents, nickels, and dimes in Denver during 1996. At that time the quarter dies and the half dollar dies could not be satisfactorily completed with a single hubbing. By the end of 1996, the die making shop at the Philadelphia Mint also had the single-squeeze hubbing presses installed so that in 1997 they too began producing dies with the single-squeeze process. In 1997 some of the problems were ironed out and the quarter dies began to be produced by the single-squeeze method.

Both facilities still had problems with the half dollar dies using this new method. Those problems were soon eliminated as well. The Mint subsequently announced that beginning in 1999 all dies were being produced using the new single-squeeze hubbing process.



*This is one of the hubbing presses in use in the die making shop at the Philadelphia Mint in June of 1998. It is a **single-squeeze hubbing press**. It allows dies and hubs to be produced with just a single hubbing as opposed to the multiple hubbings that were required in the past.*

Since billions of coins for each denomination are made each year, a single Master Die could not be used to strike all of these coins. The average die life in the past had been somewhere around 600,000 coins to 1,000,000 coins. Improvements in die steel have allowed modern dies to strike up to two million coins and often even more than that. Despite the improved die life, thousands of dies would still be needed to meet the coinage demands for each denomination in a given year.

As a result, the Master Die for a given year is then used in the hubbing press to create Working Hubs. Hundreds of Working Hubs could be produced from the Master Die. Each Working Hub could then be used in the hubbing press to produce hundreds of Working Dies. The process used to make the Working Hubs and the Working Dies is exactly the same as that used to make the Master Die. The Working Dies would then be used in the coining presses to strike the coins.

This is certainly a brief overview of the die making process and certain aspects of that process have changed over the years. Often times the changes that were made were done to eliminate the possibility of certain types of varieties that were being produced. As we look at the various types of varieties in the months ahead, we will explore those aspects of the die making process much more closely.