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6—4344

55108-, 1917. CARLISLE File No. 921

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JUN -2 1917

Mr. John Francis, Jr.,

Supt. Carlisle School.

My dear Mr. Francis:

Will you kindly send for my personal use a comprehensive, though not lengthy, statement relative to the number of Carlisle boys now employed in the Ford automobile works, with such interesting data in that and other like employment of your students as you have at ready command?

Sincerely yours,

(Signed) Cato Sells

5-EWB-31

Commissioner.

JOHN FRANCIS, JR.,
SUPERINTENDENT

DEPARTMENT OF THE INTERIOR

UNITED STATES INDIAN SCHOOL

CARLISLE, PA.

June 4, 1917.

The Honorable,
Commissioner of Indian Affairs,
Washington, D.C.

Sir:

In response to your letter of June 2, 1917 requesting information regarding the Carlisle boys now employed at the Ford Automobile works, I have the honor to advise you that at the present time there are 36 Carlisle boys enrolled with the Ford Motor Company, a class of 18 having left the school last Wednesday. In addition, five or six Carlisle boys who enrolled at the Ford works have enlisted in the Army and have been granted leave by the Company.

Carlisle gives preliminary instructions in blacksmithing to all these boys before they go to the factory. When they reach the factory they are enrolled in the student corps and in addition to working eight hours a day they are required to go to the factory four nights per week and take up mechanical drafting and a technical course in automobile engineering. They are kept very busy and are not in danger of getting into bad habits. In addition to this the Ford Company has a force of men who investigate sleepy-eyed employees, and if it is found that they are not making the proper use of the advantages offered by the Company the employee is promptly dismissed.

Most of the Indian boys have made good. As a special example of what they are doing I invite your attention to the case of Everett Ranco who, while he was employed in the factory, accumulated in wages in this office approximately $750, and upon completion of his work in the factory he was given charge of a local branch in Detroit and his savings have now been turned over to him.

Joe Gilman has the record of assembling a Ford car faster than any other employee, having done it in one hour and fifty minutes. He is now in charge of

a Minneapolis branch receiving a salary of $130 per month and his commission which approximates $3000 per year.

David Bird has been recently transferred to the Charlotte, North Carolina, branch at a salary of approximately $90 per month, plus his commission.

Leslie James has been transferred from the students' course to the tool making department, which requires the most highly skilled labor, and is drawing the full $5.00 per day.

Before going to the Ford factory they are given, in addition to the requirements of the new course of study, a course in shop mathematics, are required to study the Ford Manual and to do seven lessons in forging as shown by the lessons attached.

You might be interested in knowing that John McDowell, a student of this school, has completed a short course at the Lanston Monotype school in Philadelphia and has been put in charge of a machine on a New York paper. I have not been advised of his pay but it is very good. His brother, Donald, is now in school at Philadelphia and will, in the natural course of events, obtain a good position.

Our boys are doing very well indeed in the Navy. Fred Broker, a petty officer of the U.S. Torpedo Boat Destroyer Roe, is receiving a salary of $71 per month. Four boys who enlisted a month and a half ago have been made petty officers. Four more boys left the school this morning, having passed the physical examination to be enrolled in the Navy, and eight boys left to be enrolled in the Army. Carlisle has one former graduate at the Officers' Training Camp at Fort Niagara.

Sincerely yours,

John Francis Jr

Superintendent.

JF/S

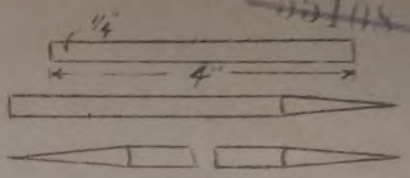
MECHANIC ARTS DEPARTMENT
Carlisle Indian School,
Roy H. Bradley, Director.

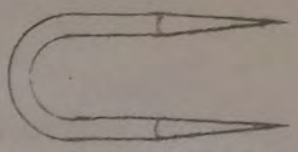
BLACKSMITHING - Lesson 1

Stock:
1 piece iron 1/4" round, 4" long

Tools:
Hammer & tongs

Operations:
Drawing out, Bending





Drawing out:-Whenever iron is reduced in thickness, or lengthened, it is said to be drawn out. This piece of iron is to be drawn out to a point at both ends. The drawn part to be left square. The piece when drawn out will be about 5" long. The only tools required are the hammer & tongs for this operation.

The blacksmith will have use for several kinds and wieghts of hammers, but the one most commonly used is called the ball peen hammer (Fig.-1) This form of hammer may be had in various weights but one weighing two pounds is right for most work.

The tongs used for this lesson will be more commonly used than any other form. They are shown in Fig. 2, which gives a side view and an end view of of the jaws grooved for holding round stock.

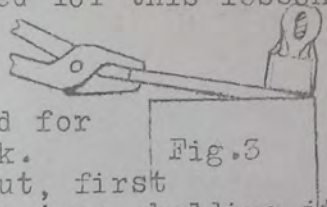


Fig.3

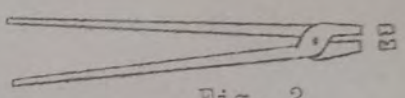


Fig. 2

In drawing out, first heat one end of the iron, holding it with the tongs in the centre of the fire, and turn on the blast. Take it out from time to time for examination. It should be heated brighter than a red, but not so hot as to burn or sparkle. When sufficiently hot withdraw and hammer for a distance of about one inch from the end, forcing the metal to flow toward the end. Turn the piece quarter round and hammer toward the end in the same way, hammering more at the end than farther so as to make it smaller there. This will make it square and smaller than the original diameter. Continue the hammering toward the end until it becomes pointed. When drawing the end down to a fine point, it is necessary to hold the end at the edge of the anvil so as not to strike the anvil. (Fig 5) If you strike the anvil instead of the iron, the hammer will rebound with considerable force and might strike your face, besides splintering off some chips from the edge of the hammer. Draw out the other end in the same way. In drawing out, take as few heats as possible but do not continue hammering after the iron has Fig 5) black cold, for it will surely split if you do. If the iron is not heated hot enough, it will also split.

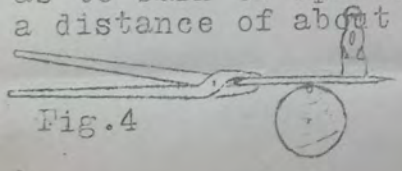


Fig.4

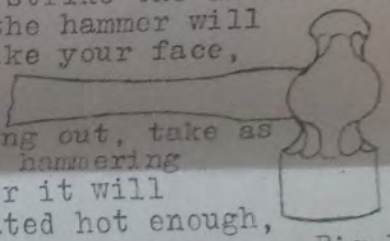


Fig 1

Bending: When both ends have been drawn out, heat the iron and bend it at the middle point, holding it as in Fig. 4, and striking not above the horn of the anvil but just beyond it. As the iron bends, continue striking it, holding as in Fig.5,

MECHANIC ARTS DEPARTMENT
Carlisle Indian School
Roy H. Bradley, Director.

BLACKSMITHING - Lesson 2

Stock:
1 piece of iron3/8" square, 9½" long

Tools:
Hammer, tongs and flatter

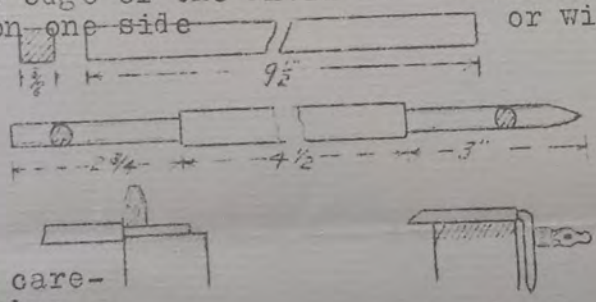
Operations:
Drawing out ends, forming shoulders, bending, twisting.

Drawing out:- Ends: Draw out the two ends, ¼" square, one of them 2¾" long, the other 3" long, leaving 4½" in the middle full size.

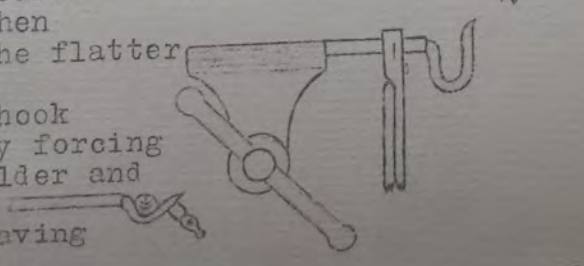
Always draw out stock square before rounding off, so as to prevent the iron spliting. When the ends are drawn out square and to the size required, round off the corners, making as smooth as possible. The end drawn out 3" long should be pointed.

Forming the shoulders:- In forming the shoulders heat the iron and place on the anvil at a point 2½" from one end. Place the flatter or set hammer directly over the edge of the anvil and hammer down approximately to size. Turn the iron one quarter round and repeat the operation. Treat the other end in the same way. Hammer down the corners and make smooth and round, using the flatter with the hammer.

If you are not carefull in placing the iron on the anvil or the flatter directly over the edge of the anvil you will not get a good shoulder. If you do not use the edge of the anvil as well as the flatter the iron will be reduced only on one side or will be off centre.

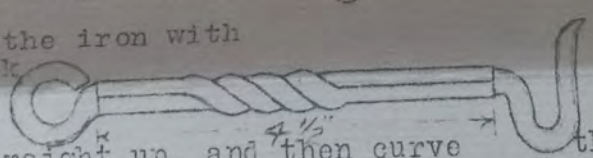


The flatter or set hammer is not intended to be used as a hammer, but is shaped somewhat like one; and is used where the hammer marks would mar the iron. It is impossible to hammer hot iron so carefully that no marks show, and when these marks are objectionable the flatter or some similar tool is used.



Bending:- Bend the eye of the hook first as shown in the drawing by forcing the end down square at the shoulder and then hammering it around the horn of the anvil to a circle having an eye ½" in diameter.

Be careful not to mar the iron with hammer marks. Next bend the hook in the same way, except that the point is not brought around in the form of a circle, but straight up, and then curve the point out a trifle. The bending of the hook should be in the same direction as the eye.



Twisting:- In twisting the shank of the hook, heat it to a bright yellow heat, being carefull not to burn it, as the smaller the piece of iron the more quickly it heats and burns. Quickly place it in the vice, and with the tongs placed as in the figure, twist one-half round and taking second hold, twist the rest of the way around. Straighten out on the anvil. The position of the hook in the vice, and the place of the tongs on the hook will determine the kind of twist that will be given. The closer the tongs are to the anvil, the shorter the twist.

In case the iron for the gate hook must be cut from a piece two or three feet long, it will be necessary to determine what length of stovk to cut off. To do this, take a piece of copper wire and bend it with the fingers the exact shape of the gate hook that is desired. Cut off the wire and straighten it out. This gives the length required.

MECHANIC ARTS DEPARTMENT
Carlisle Indian School
Roy H. Bradley, Director.

BLACKSMITHING - Lesson 3

Stock:
1 piece iron 1/2" round, 7" long

Tools:
Hammer, Tongs, Heading tool

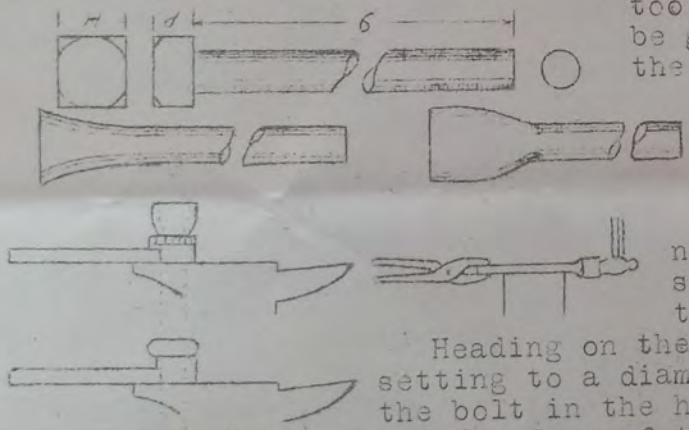
Operations:
Upsetting the head; Heading on the heading tool; Squaring the head; Chamfering the corners.

Upsetting the head:- The size of the head of the bolt bears a definite relation to the diameter of the bolt. The formula is H = 1½ x d plus 1/8. H is the short diameter of the head, or, as it is called, the distance across the flats, d is the diameter of the bolt, ½" in this case. The formula in this case would read-- H = 1½ X ½" plus 1/8 = 7/8".

The thickness of the bolt head is always equal to the diameter of the bolt.

Upsetting is the process of shortening the length of a piece of iron and increasing its width, thickness, or diameter. Usually a piece is upset by holding firmly in the tongs, with the ends of the tongs resting against the leg, and hammering on the hot end.

The hottest part of the iron will be upset most, and as the end is usually the hottest part, it will be upset the most, and too much sometimes. This can be guarded against by cooling the tip end by dipping in water just before upsetting. This will cause the part still hot to be upset, but not the end. Several heats will be necessary, and the bar should be straightened between heats.



Heading on the heading tool.- After upsetting to a diameter of about 1", place the bolt in the heading tool, which should be placed flat side down on the face of the anvil, allowing the bolt to extend down through the square hole in the end of the anvil. Hammer the head down to a thickness of ½" and smooth with the flatter.

Squaring the head.- In squaring up the head, heat to a white heat, and hammer alternately on the four sides, taking pains that each of the four sides is the same distance from the shank of the bolt, or you will likely have a bolt head that is off center, or lopsided. The metal will be forced out over the head, so it will be necessary to place it in the heading tool several times to hammer it back into shape. Make the head the required size, 7/8" square and ½" thick.

Chamfering the corners.- The corners of the upper surface, if left as they are now, would catch the clothing, and cut and mar anything that happened to hit them. To prevent this as well as to make them more sightly, they should be chamfered off. Place in the heading tool and hammer down the corners slightly, being sure that you do not destroy the squareness ofthe head.

MECHANIC ARTS DEPARTMENT
Carlisle Indian School
Roy H. Bradley, Director.

BLACKSMITHING - Lesson 3

Stock:
1 piece iron 1/2" round, 8" long.

Tools:
Hammer, Tongs, Heading tool

Operations:
Upsetting the head; Heading on the heading tool; Squaring the head; Chamfering the corners.

Upsetting the head:- The size of the head of the bolt bears a definite relation to the diameter of the bolt. The formula is H = 1½ x d plus 1/8. H is the short diameter of the head, or, as it is called, the distance across the flats, and d is the diameter of the bolt, ½" in this case. The formula in this case would read- H = 1½ x ½" plus 1/8 = 7/8".

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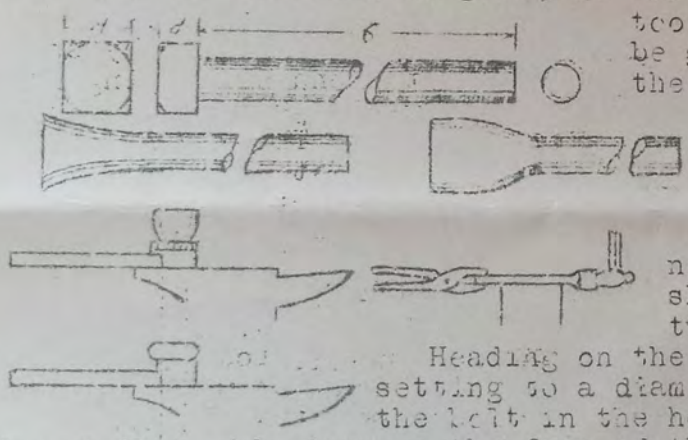

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MECHANICS ARTS DEPARTMENT
Carlisle Indian School
Roy H. Bradley, Director.

BLACKSMITHING - Lesson 4

Stock:
1 pc. iron 3/8" round, 10" long, for link
1 pc. iron 3/8" X 1", 7" long, for hook
1 pc. iron 3/8" round, 10" long, for ring

Tools:
Hammer, Fullers, Punch

Operations:

For Link	For Ring	For Hook
1. Measuring.	1. Measuring.	1. Measuring.
2. Bending.	2. Scarfing.	2. Fullering.
3. Scarfing.	3. Bending.	3. Punching eye.
4. Welding.	4. Welding.	4. Shaping hook.
		5. Bending hook.

Link

1. Measuring.- When the length of stock is given, as in this particular exercise, this operation is unnecessary. However, if the stock must be cut from a longer bar of iron, it is necessary to determine what length of iron is necessary to make a link of the required size. Let Fig. 1 represent the link to be made. An inspection of this figure shows that it consists of two semicircles, one at each end, and two straight pieces, one on each side. The

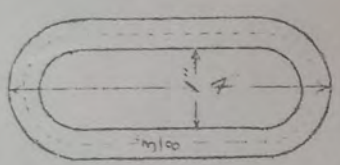


Fig. 1 - Measuring the length of iron necessary for link.

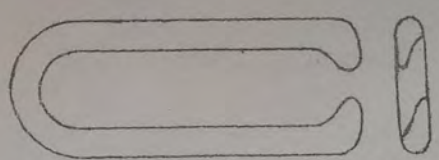


Fig. 2 - Ends of link scarfed.

putside dimensions of thelink are 4" X 1¾" and the stock is 3/8" ound. We take all measurements along a center line, indicated by the broken line in Fig. 1. This line has a radius of 11/16" at the two ends and a length of 2¼" along each of the two straight sides. The two semicircles make a complete circle with a diameter of 1-3/8", and as the circumference of a circle equals 3,1416 times the diameter, the circumference of this circle along the middle

Fig. 4 - Scarfing ends of link over edge of anvil.

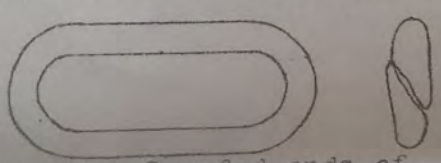


Fig. 3 - Scarfed ends of link ready for welding.

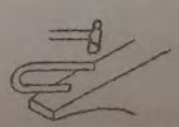


Fig. 5 - Scarfing ends of link with ball peen hammer.

line equals 4-5/16". The length of the two sides equals 2 times 2¼", or 4½". The total length is 8-13/16". The length of stock required when we make allowance for welding is 10".

2. Bending - The operation of bending is very simple. It has been explained in the lesson on the Staple.

3. Scarfing - Scarfing the ends of the link to be welded consists of flatting out the ends with the ball peen of the hammer or over the edge of the anvil so that when bent around, the ends will overlap for the weld.

Fig. 2 shows the two ends scarfed ready to be bent together, and Fig. 3 shows them overlapped.

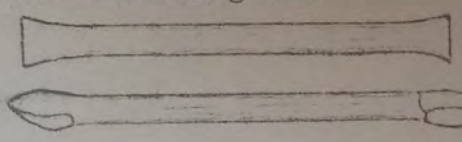
Figure 4 shows the method of holding the link over the edge of the anvil in scarfing. Hammer the end at a down until it looks like the ends in Fig. 2, then reverse and scarf the other end on the opposite side in the same way. Figure 5 shows how to hold the link and hammer when scarfing with the ball peen on the face of the anvil.

4. Welding.- In heating a piece of soft iron or mild steel, the metal gets softer and softer until it becomes pastry and then melts; and if the heating is continued, the iron burns and becomes worthless. There is a point of temperature at which if two pieces are placed together, they will stick, or be welded so that they cannot be pulled apart when cold. First, then, it is necessary to heat the iron to a proper temperature, a welding heat. Second,

it is necessary to force the pieces of iron together by hammering. Third, it is necessary to hammer the joint to the proper shape.

If the iron is heated too rapidly, the surface comes to a welding heat before the interior, and a strong joint is impossible. If the iron is burned, a weld is impossible. If the iron is heated in a dirty fire, one full of slag and cinders, the particles of slag get into the weld and prevent a strong joint. If the edges of the scarf are too thin, they will cool so quickly as to get below the welding heat before the union can be made, and a weld will not be complete. If the scarfs have not been lapped far enough, the welded joint will be smaller than the rest of the iron, and consequently the weakest part of the link. In view of these facts it is necessary to have the following:

(1) A clean fire of coke. Clean out all the cinders and pile the coke into a mound over the tuyere. Turn on the blast and place the ends of the link in the middle of the fire, just above the tuyere, but not too close to the latter, or the cold blast will prevent a welding heat.



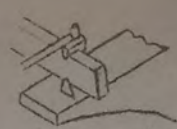


Fig. 7, Using top and bottom fullers.

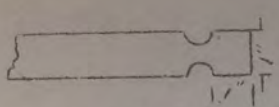


Fig. 8 - Stock fullered.

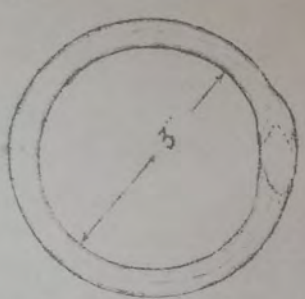


Fig. 6 - Steps in making ring.

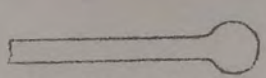


Fig. 10 - End drawn out.

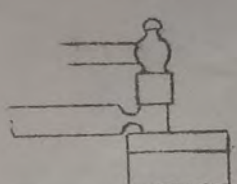
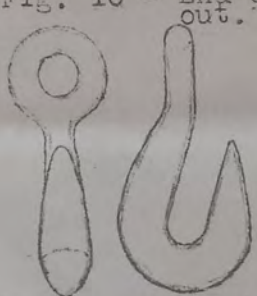


Fig. 9 - Flatting out the fullered end.



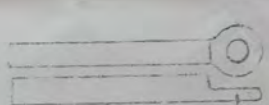


Fig. 12 - Enlarging the eye over the horn.

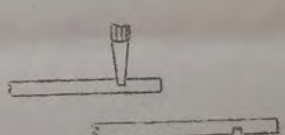


Fig. 11 - Steps in punching the eye.

Fig. 15 - Completed hook.

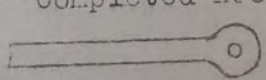


Fig. 13 - Eye punched in end.

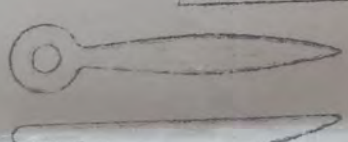


Fig. 14 - Shape of hook before bending.

(2) The iron must be raised to the proper temperature. If two pieces of the same size are to be welded, they will heat evenly; but if two pieces are unequal in size, the larger will heat more slowly, hence it should be placed in the fire before the other.

(3) It is necessary to heat the iron clear through to a welding heat, and not merely on the surface. You can do this better with a slow fire than with one burning fiercely.

(4) The thin edges of the scarf must be welded down first, as they will cool most rapidly. After the edges are stuck, then the rest of the iron can be welded into a good strong joint.

(5) Lap the scarfs far enough so that the welded joint will be larger than the rest of the iron, then it can be drawn down to size; but if the weld is too small, it cannot be upset except with great difficulty.

In most welds, the ends to be welded should be upset before they are scarfed so as to insure the proper size; but in the case of the link, the upsetting will be unnecessary, as the lap will provide enough extra metal to insure a good size to the joint. If the weld has not been entirely successful, reheat the iron and finish it. Remember that no amount of hammering will weld iron that is not at the welding heat, and that quick light strokes will weld just as surely as strong heavy blows and will not reduce the size of the iron so much. When the second link has been welded, and the third is ready for welding, place the two welded links on the third before

welding it. Continue this until a chain of the proper length has been made. The length will be determined by the use to which the chain is to be put when completed.

Ring

1. Measuring - The inside diameter of the ring is 3"; and as the iron is 3/8" round, the diameter of the middle line is 3-3/8", which, when making allowance for the weld, means a circumference of 10", the length of stock required.

2. Scarfing - Upset the ends, and scarf them to a point, remembering to scarf them on opposite sides.

3, 4. Bending and Welding - Bend in the shape of a ring with the ends overlapping. Before closing the ring, place the end link on the ring and weld. The process of bending and welding are the same as those given for the link.

Hook

1. Measuring - The length over all is $3\frac{1}{2}$" and the diameter of the middle line at the curve is 1". The point returns for a distance of 3". This makes a total length of 7" along the middle line.

2. Fullering - Fullers are used in rounding corners and making grooves. The top fuller is fitted with a handle, and the bottom fuller has a stem that fits into the square hardy hole in the end of the anvil. (See Fig.7.) Figure 8 shows the piece when fullered to a depth of 5/16". Hammer down the end until flat and round and 3/8" thick (Figs. 9 and 10).

3. Punching eye.- With the punch placed in the center of the flattened head, punch one half through the hot iron (Fig. 11). Reverse the iron and punch from the other side. Drive the punch through from each side, enlarging the hole. (See Fig. 13.) The edges of the hole should be rounded on the horn of the anvil by holding it as shown in Fig. 13 and hammering around the outside edges, making a smooth round eye with the metal the same thickness all around.

4. Shaping the hook.- The hook should be shaped complete before being bent. Figure 14 shows the shape required. Begin hammering at the eye and work towards the tip. A hook has a tendency to straighten out when strained, so to prevent this it must be strongest at the bend; therefore at that place the iron is left widest and thickest. The end view in Fig. 14 shows the best way to taper the iron towards the back.

5. Bending the hook.- Bend the hook as in Fig. 15. Remember that the middle point of the bend must be opposite the eye of the hook.

The opening in the hook should be $\frac{1}{2}$" so as to easily accommodate the 3/8" links. This form of a hook is called a grab hook, because it will grab or hold a chain at any place, as the opening is not large enough for a link to slip through except flatways.

BLACKSMITHING - Lesson 5

Stock:
1 pc. iron 7/8" X 7/8" X 4",
1 lc. iron 3/8" round, 6" long.

Tools:
Hammer, Punch, Fullers, Swages.

Operations:
Fullering, Drawing Out; Punching; Swaging head; Shaping ring and welding; Upsetting pin in place; Welding link.

1. Fullering.- The head of the swivel must be left full size; so on each side of the head, fuller down to within ¼" of the bottom, leaving a block 1" long, as in Fig. 2 in the middle of the bar. Fuller on the top and two sides, but not on the bottom. In this first operation, use the top fuller only, but when fullering the sides use both the top and bottom fullers.

2. Drawing out.- Draw out the two ends to ½" round; make them even the entire length, and smooth down with the top and bottom swage as in Fig. 3. A swage is a small tool with the face grooved. Most swages have a semicircular groove, but some have angular grooves. They come in pairs and in different sizes. A top swage has a handle like a flatter and a top fuller, while the bottom swage has a stem that fits into the square hardy hole. These tools are generally used to give a finish to the work. (See Fig. 4)

3. Punching.- The hole for the stem of the eye or ring can be punched with a small-sized punch and then enlarged by using larger punches. The hole must be perfectly round and straight in order that the swivel may work easily.

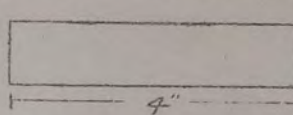


Fig.1, Iron for link of swivel.

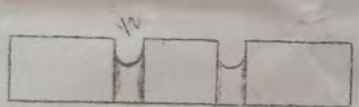


Fig.2.- Iron fullered.

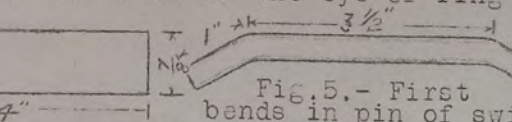


Fig.5.- First bends in pin of swivel.

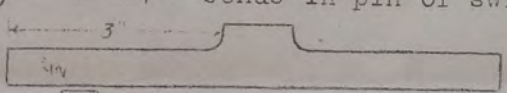


Fig.3 - Iron drawn out.

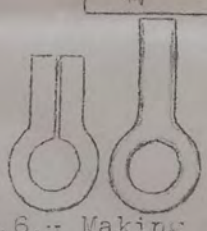


Fig.6.- Making eye in pin of swivel.

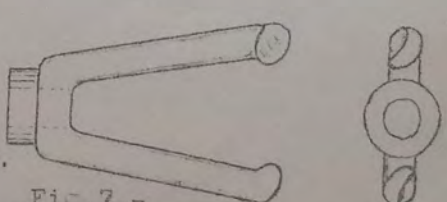


Fig.7.- End scarfed for welding.

Fig. 4 - Swaging tools.

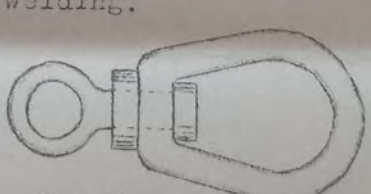


Fig.8.- Completed swivel.

4. Swaging the head.- When the hole has been finished, fit into it a pin of ½" round iron or steel and hammer the head round, using the hammer at first, then the top and bottom swages to finish. (See Fig.4) This operation will be rather difficult, but by taking pains one can make a good looking head. The pin must be kept in the hole during the operation to prevent it from being hammered out of round and reduced in size.

5. Shaping ring and welding.- In shaping the ring, bend the two ends of the round piece of iron as shown in Fig. 5. Then bend the middle part into a ring over the horn of the anvil, weld the two parts of the stem together and draw down to a round stem ½" in diameter (Fig. 6). Use the top and bottom swages in finishing.

6. Upsetting pin in place.- Before upsetting the pin, bend the two arms of the link as in Fig. 7 and scarf the two ends for welding, but leave them far enough apart so that the hammer can be used between them in upsetting the stem of the ring. Heat the stem of

the ring to almost a welding heat, and introduce it into the hole and upset, holding the tongs against the leg for support. The upsetting should be done in one heat, as it will not do to heat the link and ring together or the head of the link will be hammered out of shape. Therefore, heat the stem to a high temperature and work rapidly while the iron remains hot. The stem should not be upset too much or it will bind when the arms are welded together, and the swivel will be useless because it will not swivel.

7. Welding the link.-- Weld the arms together and shape as represented by Fig. 8.

MECHANICS ARTS DEPARTMENT
Carlisle Indian School
Roy H. Bradley, Director.

BLACKSMITHING - Lesson 6

Tongs

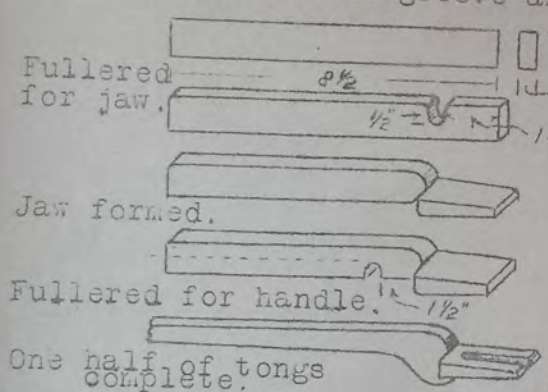
There are a great variety of tongs used for various purposes, as bolt tongs used for holding bolts, pick-up tongs used in picking up small pieces of hot iron from the floor, tire tongs used in holding tires, etc.

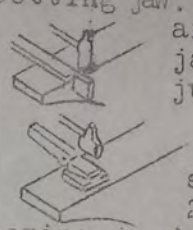
Stock:
2 pcs. of iron $\frac{1}{2}$" X 1" X $8\frac{1}{2}$", 1 pc. of iron 3/8" round, 2" long.

Tools:
Hammer, Tongs, Fuller, Flatter, Swages, Punch, Sledge.

Operations:
Fullering; drawing and flatting jaws; drawing and swaging handles; grooving jaws; punching holes; riveting bolt.

1. Fullering.- Make a chalk mark $1\frac{3}{4}$" from one end of one of the long pieces of iron, and fuller down to a depth of $\frac{1}{2}$". The chunk of metal between the groove and end is to be drawn out for the jaw.




Upsetting jaw.

Fullering jaw.

(All operations given here are the same for the two jaws.) $1\frac{1}{2}$" from the groove just fullered, fuller another groove to the same depth, but on the opposite edge of the iron.

2. Drawing and flatting jaws.- Draw down the jaws until they are 3/8" thick at a and $\frac{1}{4}$" thick at the end b. In drawing the jaw down to this thickness it will spread out sideways, and care must be taken that it spreads in one direction only. To secure this, lay it on the edge of the anvil and hammer the opposite edge flat and even with the side of the piece of iron. When the jaw has been drawn to the proper shape and size, shape it up smooth with the flatter or set hammer.

3. Drawing and swaging handles.- Draw out the handle from the fullered groove to the end, tapering from $\frac{1}{2}$" square at the shoulder to $\frac{1}{4}$" round at the end. This drawing will be rather heavy work for the hammer, so it will be better to have some one help by using the sledge, which is a heavy hammer with a longer handle and intended to be swung with two ends. One must be careful in using the sledge not to strike too hard, as a heavy blow on the anvil will injure both the anvil and sledge. When the handle has been roughed out to size with the sledge, finish the work with the top and bottom swage.

4. Grooving jaws.- If the tongs are to be used in holding round stock, the jaws should be grooved with the top fuller and the bottom swage; but if the tongs are for flat work as well as round or square stock, they should be grooved slightly with the top fuller but not swaged. The drawing shows how to hold the jaw when grooving it for round stock. It is held in the same way for flat stock except that the jaw rests on the face of the anvil instead of on the swage.

5. Punching holes.- Punch a 3/8" hole in the joint, punching from both sides so as to get the sides of the hole straight and parallel. The jaws should be fitted together with the rivet in place, but not riveted, as it will probably be necessary to do some fitting and shaping before they will fit and work smoothly. If one is longer than the other, it can be upset, or the shorter one drawn out; and the joint must be very smooth and flat in order to have the tongs work well and close completely.

6. Riveting the bolt.- Upset one end of a piece of 3/8" round iron or steel, using a heading tool to make a rivet head; cut it off $1\frac{1}{4}$" long and heat and drop in the hole; and then rivet the other end with the ball peen of the hammer, taking care that it is not riveted so tight that the jaws cannot be moved when the iron is cold. When a heavy pair of tongs is wanted, make the jaws out of heavy iron and the handles out of lighter stock so as to make the work of drawing down easier.

MECHANIC ARTS DEPARTMENT
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BLACKSMITHING - Lesson 7

Harness Hook

Stock:
1 pc. iron 3" X 1½" X 3/8"
1 pc. iron ¼" diameter, 6" long

Tools:
Hammer, Tongs, Drill or punch, Flatter, Swage.

Operations:
Drawing out hook; scarfing plate and hook; welding and punching holes.

1. Drawing out hook.- Draw out the iron for the hook in a straight piece, working from the large end toward the small end. If you were to reverse the direction, the small end would get so hot on account of its smaller size that it would burn before the larger part was hot enough to work.

Draw the piece approximately round the entire distance, and when straight and smooth, finish with the swages. As the sectional views in Fig. 1 indicate, the hook is not round the entire distance, but elliptical for a part of the way; so, with the flatter, flatten out slightly until it is of the dimensions given in the drawing. The tip should be upset slightly and rounded off into the form of a ball so as to prevent any cutting or scratching of the harness.

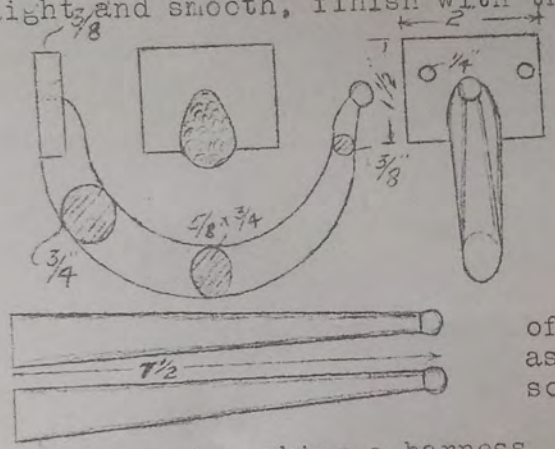

Fig. 1.- Steps in making a harness hook.

2. Scarfing the plate and hook.- The large end of the hook is upset and scarfed as for a lap weld. The plate is scarfed by hammering a depression in the surface along one side with the ball peen of the hammer. This will force some of the metal to bulge out beyond the edge. Do not let it get too thin. This is a difficult weld to make properly.

3. Welding and punching holes.- The two pieces cannot be held together and welded very easily by one man, so a helper will be needed. Heat both pieces to the welding heat, and place together quickly on the anvil.

Hammer down the tip of the hook first and then reverse and hammer down the scarf on the plate; afterwards weld the body together. It may take two heats for this weld. Unless it is a complete success, the hook will not be strong enough to hold any weight, as most of the strain comes on the weld. Drill or punch two holes for the screws, and bend up the hook to the proper shape.