OXHYDRIC PROCESS OF CUTTING METALS.—III.*

TORCHES AND MACHINES THAT CUT STEEL.

BY E. F. LAKE.

Concluded from Supplement No. 1755, page 117.

CUTTING UP AN ARMORED CRUISER.

ONE of the most interesting jobs which has been done with this process was the taking apart and cutting into scrap of an old English armored cruiser, which had been bought by a firm in Hamburg.

The method which had been employed formerly was to cut the rivets off, drive them out, remove the armor plate, notch it with compressed air tools and then

the various metals that can be fused together. The flame, however, must be the opposite of that used for cutting metals, as it must be one that freely reduces the oxide, rather than one causing oxidation, as is used in cutting, as oxides in the welds are inadvisable.

The apparatus used for welding is shown in Fig. 21. By this it will be seen that the same two oxygen and hydrogen bottles are used and that the gas is piped

formed by melting metal from a rod, with the torch. If the metal is properly fused by this method a fairly good joint is obtained, but if the operator allows globules of metal to fall from the rod and drop on metal which has not been properly melted, the two do not fuse together and a poor joint is the result.

WELDING THICK METAL.

The German Oxhydric Company adopted a different

FIG. 13.—CUTTING CAST-STEEL FRAME FOR PROPELLER SHAFT.

break it up under a drop. To complete the work by this old method usually took 1½ years. Now, with the oxhydric process, the job was completed in 2½ months.

In Fig. 13 the hull of the boat partly dismantled is shown, and to the right of the picture, the workman is seen cutting up the cast-steel frame for the propeller shaft. The propeller shaft is shown, as it was being cut up, in Fig. 14. It was 18 inches in diameter and the cuts were made in 17 minutes.

The armor plate, as it was being cut up, is shown in Fig. 15. Some of this was 14 inches thick and some of the heaviest guns which were cut up had an outside diameter of more than 40 inches. All the metal in the boat was cut to sizes suitable for charging in the furnaces for remelting.

CUTTING PLATES AND STEEL CASTINGS.

As a manufacturing proposition, the oxhydric process is equally as good as in the cutting up of scrap and Fig. 16 shows a sample of work on which it is very useful. This is a face-plate for the base frame of a locomotive. It was 9/16 inch thick, 4 feet wide by 6 feet long and about 264 lineal inches had to be cut in cutting out the opening. This work was done in exactly one hour, which is at a speed of 3¼ minutes for each running foot.

Many uses for this process will also be found in steel foundries. In Fig. 17 is shown a steel casting just as it comes from the mold, and Fig. 18 shows the same

from these to the same mixer that is used in cutting. Here, however, the similarity ceases as the extra nozzle for oxygen is not used. A torch with a single nozzle is substituted and the gas that enters the torch is piped through a single pipe from the mixer; thus only one line of armored hose, leading to the torch, is needed in place of the two.

FIG. 16.—HOLES CUT IN PLATE 4x6 FEET, 9/16 INCH THICK.

THE WELDED JOINT.

The welding done by this method leaves the metal its ductility. If the welded joint is submitted to a slight hammering, while it is cooling down to a dull red, or even to a heat treatment after it has cooled, the

FIG. 17.—STEEL CASTING AS IT LEFT THE MOLD.

FIG. 18.—SAME CASTING AFTER CUTTING RISERS, SPRUES, ETC.

method of welding metals from 3/8 to 1 inch thick, and have made many successful welds thereby. This method is to put the two ends of the metal together without overlapping, but in contact with each other. They are thus heated by two oxhydric torches, one above and the other below the metal, and exactly opposite each other, and are given as extensive a heating zone as possible.

When the metal begins to show signs of melting on the outside, the interior of the sheets are doubtless at a white welding heat; the torches are then removed and an anvil and hammer brought into use for lightly hammering the joint. This causes a readjustment of the molecules, and they join together in the weld.

THE WELDING GASES.

In welding, one part of oxygen to from four to six parts of hydrogen are used, and it is necessary to obtain a complete absorption of the oxygen, by the hydrogen in excess, in order to make a perfectly homogeneous flame. This was a difficult problem to solve

FIG. 14.—CUTTING 18-INCH PROPELLER SHAFT IN 17 MINUTES.

casting after the sprues, risers, etc., have been cut off with the oxhydric process. Fig. 19 shows another steel casting as it came from the sand, and Fig. 20 shows the same casting after the surplus metal has been cut off.

AUTOGENOUS OR FUSION WELDING.

The oxhydric process is also applicable for welding

FIG. 15.—CUTTING UP THE ARMOR PLATE, SOME OF WHICH WAS 14 INCHES THICK.

OXHYDRIC PROCESS OF CUTTING METALS.

steel in most cases can be brought back to its original structure and the joints can be made nearly as strong as the original metal.

In welding thick plates, say from 3/8 inch upward, by any of the fusion methods, it is usual to bevel or chamfer the two edges of the joints and fill the V thus

as the fear of explosion long prevented the mixing of the two gases before their inflammation.

It was overcome by assuring to the mixture of the gases a velocity greater than the velocity of the propagation of the flame, as an explosive mixture contained in a tube does not ignite instantaneously in all of its

* By courtesy of American Machinist.

mass when combustion is started at one end of the tube.

The ignition is propagated in the tube with a finite velocity which increases as the square of the section thereof. If, therefore, the gaseous mass moves toward the point of ignition with a speed greater than the speed of propagation, the flame will not reach the inside of the torch and much less that of the mixer.

Thus, having obtained a minimum for the speed to be given the gas, it is necessary not to exceed the

FIG. 19.—STEEL CASTING AS IT LEFT THE SAND.

FIG. 20.—SAME CASTING AFTER CUTTING OFF EXCESS METAL.

maximum, and this is obtained by a practical consideration, namely, that the jet of gas leaving the torch must not be strong enough to set in motion the drops of the metal which are intended to constitute the weld.

HOW THE GASES OPERATE.

In operation the two gases are carried from the steel bottles to the mixer where they are mixed as previously described from the cutting operation. From the mixer they are carried to the torch through a single tube and enter this where there is a sharp enlargement in its shape. This considerably diminishes the velocity of the gases, and from there they pass through a conical tube that is perfectly smooth on the inside. This tube gradually diminishes in size down to the nozzle, and the speed of the gases gradually increases again until the minimum speed required is obtained.

SAMPLE OF WELDING.

As a sample of some of the fine work which can be done by welding with the oxyhydric process, Fig. 22 shows an art piece in which the leaves, petals, stems, and ribbon are worked out by a blacksmith with a hammer and anvil, and the whole was then welded together by welding the leaves and petals to the stem.

THE FORERUNNERS OF THE METALLIC FILAMENT INCANDESCENT LAMP.

By DR. C. RICHARD BÖHM.

The power of the alkaline earths and of magnesia to emit an intense light when heated was already well known when the electric arc light came into use, and therefore it was only natural that attempts should have been made to use those substances in the electric lighting industry. Early trials made with them proved temporarily successful, but they were superseded by the rapid development of the electric arc and the electric incandescent lamps. Then came the incandescent gas mantle, and the desire to compete with it caused further experiments to be made with a view to utilize these rare earths which had proved so successful with gas.

At first the oxides or salts were mixed with powdered carbon and ground to a paste with an organic binding material, viz., gum, coal-tar, molasses, etc. Out of this paste filaments were formed by pressing, and these, after being coated with carbon powder, were subjected to red heat. Further on, organic fibers or collodion threads were impregnated with solutions of suitable salts, or carbon filaments were used, and these were coated with light-emitting earths or oxides, which may be termed conductors of second class order, or with metals, which are conductors of first class order. Then a filament of metal was given a trial, and for this

purpose the metals of the platinum group, which have such a high fusing point, naturally received the first consideration. The manufacture of a filament of osmium, which is so brittle, but has such a high fusing point, offered considerable difficulties. These were, however, overcome by Auer, who with his osmium or osram lamp, put a weapon into the hands of the electric lighting industry which first made it possible to compete on more equal terms with the incandescent gas light.

All the proposals for manufacturing filaments for electric incandescent lamps out of a compound of conductors of first and second class order have hitherto led to no practical result. The reason for this is to be found in the effect of the high temperature in the glowing filament and the subsequent chemical reaction. It is now considered beyond doubt that the formation of carbides plays an important part in the destruction of the filaments of this sort. In this respect the German patent No. 128,925 of 1902 of Just and Falk does not help to overcome the difficulty, because experience has so far taught that filaments cannot be made from zirconium or its oxide without organic binding material. The same may be said of the German patent of Kellner (No. 138,468), according to which the mantles are to consist of thorium or titanium, intermixed with their oxides.

In choosing a filament of carbon or metal in combination with conductors of first and second class order, it must be remembered that the outside coating of oxide will have a section five or six times as large as that of the core. In order to create the heat for making the filament glow, a current of such strength has to be carried by the core that it would also be volatilized. The alternative way is to coat a core composed of conductors of second class order with a conductor of first class order. Such a proposal is to be found in the classical patent of Jablochhoff and in an English patent.

By using mixtures of two or three oxides instead of magnesia or zirconia (with yttrium oxide, for instance), Nernst filaments were obtained; these require heating mechanisms. Scharf wanted to avoid this drawback by a combination of oxides and metals, an idea which is again met with in the German patent 128,925. According to this patent the filament is composed of a metal (Zr) and an oxide (ZrO_2). If we consider all oxides as conductors of second class order, then Bolton's idea is more to the point, as he proposes in the German patent No. 161,081 that the lower oxide of tantalum, which is to carry the electric current, shall be mixed with the non-conducting oxide of zirconium (ZrO_2), then turned into a thread, which is to be heated by the electric current in the usual way. By this process the oxide of tantalum is reduced to the metallic state, whereas the zirconium oxide is left unaltered, but in a very fine state of subdivision. This circumstance should prove a matter of great importance in the manufacture of filaments from conductors of the first and second class order, as it has been ascertained that the original materials must be in a state of

sible to manufacture useful filaments according to his German patent No. 161,081. The metal wolfram or tungsten does not offer the same drawback, because a compound of tungstic acid with conductors of the second class can be heated in a current of hydrogen to the point of the reduction to the metal, and thus the desired fine division of conductors of first and second class order may be obtained. According to a later patent, specified quantities of ThO_2 and ZrO_2 mixed with tungstic acid are fused together in an iridium crucible by means of an oxyhydrogen blow-pipe, and the highly refractory tungsten compounds are then pulverized. If this product is then heated in a current

FIG. 22.—WELDING LEAVES AND PETALS ON BLACKSMITH'S ART WORK.

of hydrogen, a combination of conductors of first and second class order in the finest division will be the result. If anyone did succeed in manufacturing filaments composed of metals and oxides of metals in a fine state of division, it could be said that the heater and filament of the Nernst lamp had been united in one single thread. It can be gathered from the German patent 187,083 that the latest endeavors are being directed toward this end, as according to this patent the conductor of the first class order consists of metallic tungsten, or a tungsten alloy, whereas the rare earths (ZrO_2) and ytterbium earths are selected for conductors of the second order.

At present no satisfactory way of doing away with the organic binding material appears to have been discovered, and as the rare earths easily unite with car-

FIG. 21.—THE OXYHYDRIC WELDING APPARATUS AT WORK.

OXYHYDRIC PROCESS OF CUTTING METALS.

the finest possible division, and this condition can ordinarily only be attained with the greatest difficulty. It is a well-known fact that it is almost impossible to mix the more or less ductile metals intimately with oxides.

Although the idea of Bolton was perfectly correct, he was foiled through the great affinity of tantalum metal for hydrogen, and therefore it was impos-

bon, the resulting filaments must contain carbide. It may be mentioned that Léon de Somzée of Brussels protected in 1899 a filament made of silicon to which he added some rare earths (oxides) for the purpose of increasing the emission of light.

Tungsten carbide, which is formed intermittently, is decomposed at the temperature of the glowing filament, so that metallic tungsten is left, and the carbon is, as