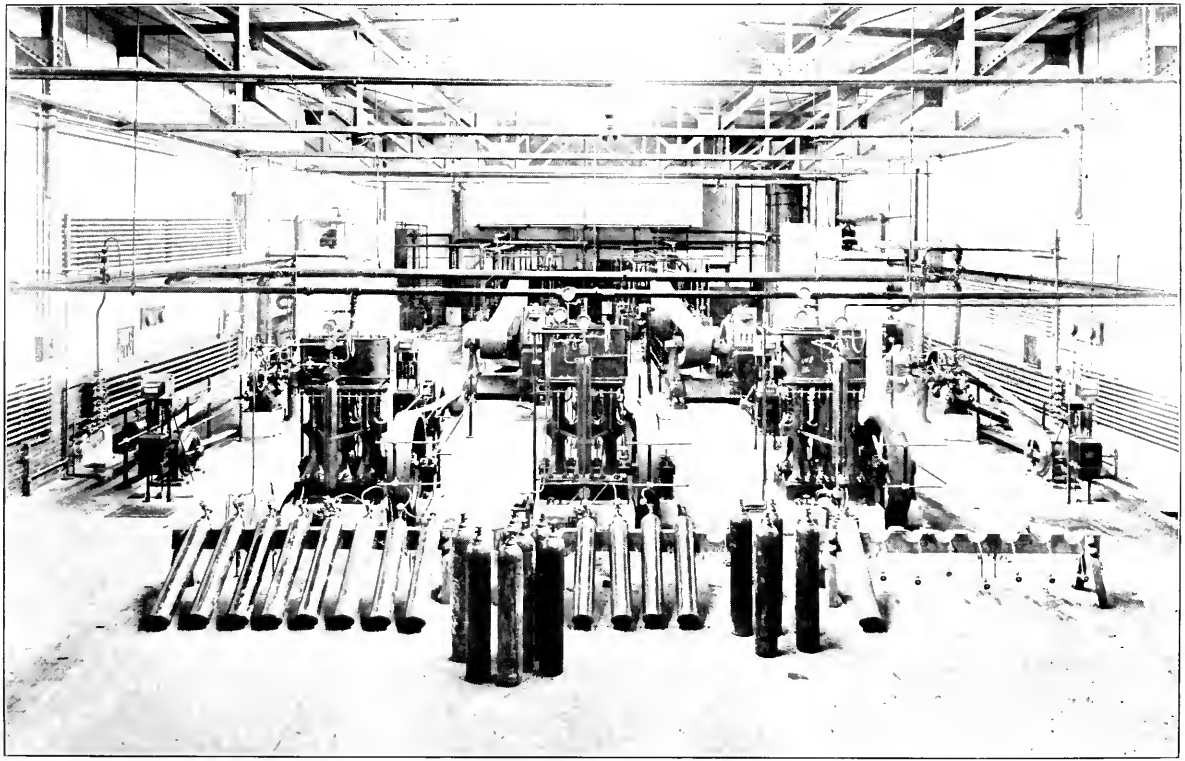
THE LINDE AIR PRODUCTS COMPANY



BUFFALO OXYGEN PLANT.

The Linde Air Products Company

OFFICES:

BUFFALO. CHICAGO. CINCINNATI.

CLEVELAND. NEW YORK.

PITTSBURGH.

WORKS:

PLANT No. 1. BUFFALO. PLANT No. 2. CHICAGO. PLANT No. 3. ELIZABETH. PLANT No. 4. TRAFFORD.

No. 184

INDEX.

List of Linde Plants at Which Compressed Oxygen May be Obtained.

United States of America:
- Buffalo, N. Y.
- Chicago, Ill.
- Elizabeth, N. J.
- Trafford, Pa.

Great Britain:
- London.
- Birmingham.
- Manchester.
- Cardiff.
- Newcastle-on-Tyne.
- Glasgow.

Germany:
- Munich.
- Cologne.
- Berlin.
- Düsseldorf.
- Mülheim.
- Kirchdrauf.
- Amberg.
- Dresden.
- Nürnberg.

Austria:
- Vienna.
- Gumpoldskirchen.
- Bucharest.

France:
- Paris.
- Toulouse.
- Marseilles.

Italy:
- Rome.
- Milan.

Spain:
- Barcelona.

Russia:
- St. Petersburg.
- Kharkof.

Switzerland:
- Lucerne.
- Bülach.

Norway and Sweden:
- Stockholm.

Holland:
- Rotterdam.

India:
- Calcutta.

Union of South Africa:
- Cape Town.

Republic of Argentine:
- Buenos Aires.

Brazil:
- Rio de Janeiro.

Australia:
- Melbourne.

China:
- Shanghai.

INTRODUCTION.

THE use of the Oxy-Acetylene Blowpipe for welding and cutting metals is now recognized as an important factor in the economical operation of modern engineering establishments. It is only during comparatively recent years that this Blowpipe has been employed on any considerable scale in the United States of America, previous to which the development of its use was limited, chiefly owing to the absence of any satisfactory source of supply of the necessary oxygen, at a price which would allow of its use commercially. Since the installation of the first plant of THE LINDE AIR PRODUCTS COMPANY at Buffalo in 1907, this handicap has been removed. The result of this has been the remarkable growth of a new industry, and to meet the increased demand for oxygen it was not only found necessary to duplicate the Buffalo Plant, but to erect other plants. In September, 1910, the Chicago Plant was constructed and put into operation by the Company, and two other plants—one at Elizabeth, N. J., and the other at Trafford, Pa.—have just been completed. In addition to this other factories will be erected in the near future. In this way an unlimited supply of pure compressed oxygen, ready for immediate use, may be obtained everywhere under the most favorable conditions for industrial application, at a price that no other known method of production can compete with.

The Company have also found it necessary to increase their facilities for the construction of welding and cutting apparatus, and have recently added to their manufacturing department two new bays, equipped with modern machine tools of all descriptions. Research and experimental work is carried on continuously, and demonstration and instruction in the use of the Oxy-Acetylene Blowpipe is given at all the Company's plants.

The Company guarantee that all oxygen supplied by them contains not less than 97 per cent. of PURE OXYGEN, and is absolutely free from the oxides of carbon, hydrocarbons, chlorine, and other deleterious impurities. All cylinders filled by the Company (whether their own or their Customers) bear one of the Company's labels when sent out from their factory, and this label guarantees the purity of the gas. Customers purchasing the Company's gas are requested to see that this label is attached to their cylinders.

The Linde process of manufacturing oxygen from the air has practically superseded all other known methods of manufacturing oxygen. At the present time many millions of cubic feet of oxygen are being produced monthly by this method, whilst the consumption is increasing daily.

Briefly explained, the process consists in the first instance in the complete liquefaction of the air to be resolved, by a process of accumulative cooling. The liquid thus formed is then submitted to a process of rectification at the same time that an almost complete transference of heat is obtained from the compressed air entering the apparatus to the liquid air thus formed. In this way oxygen to a degree of purity up to 98 or 99 per cent. can be obtained.

The Company also supply compressed illuminating (coal) gas for use in conjunction with their Oxy-Coal Gas cutting apparatus (see Circular D) and for other purposes.

Railway Classification.

All the Company's cylinders are made to their own specifications and they comply fully with the regulations provided in the "Red Book," published by the American Railway Association.

All cylinders are subject to the inspection of one of the Company's engineers during manufacture. They are carefully annealed, valved and tested hydraulically by special apparatus before being filled for the first time with gas (see pages 31, 32).

Oxygen and coal gas cylinders complying with these regulations, if shipped subject to uniform bill of lading conditions, are conveyed in carload lots under rule 26; and less than carload lots under rule 25.

Returned empties in carload lots are accepted at fifth-class rates and less than carload lots at fourth-class rates if billed as "Compressed Air Cylinders," otherwise at third-class rates.

Terms.

Customers who have not a credit account with the Company must remit cash with order, in the absence of any acceptable commercial rating. In cases where oxygen is ordered to be supplied in the Company's cylinders, a deposit is charged for book-keeping purposes to cover the value of these cylinders and the Customer's account is debited accordingly. The amount of this deposit will be refunded, less any rent charges which may have accrued (see page 30), on return of the cylinders to the Company's works, freight prepaid and in good condition.

The Company reserved the right to a beneficial lien in and to the cylinders or other apparatus sold by it to a Customer for the liquidation of any overdue outstanding or current accounts existing between it and the said Customer whenever any such apparatus or cylinders come into the possession of the Company for any purpose whatsoever, and all sales are subject to this right, unless otherwise agreed at the time.

All goods are at purchaser's risk after shipment.

In ordering, it should be clearly stated on each order how the goods are to be shipped, whether by freight, express, or mail.

In the absence of shipping instructions, the Company will ship by what they consider the best way, cheapness, quickness and safety being considered. The Company will not accept any responsibility for loss nor delay in transit, but should miscarriage or loss occur they will endeavor, in the interest of the purchaser, to have the lost goods found, or proper restitution made by the transportation company at fault.

All prices include packing and delivery f. o. b. factory, Buffalo, unless otherwise stated.

The Oxy-Acetylene System of Autogenous Welding.

The value of oxygen for obtaining high temperatures has long been recognized, and the Oxy-Acetylene welding process affords to engineers and others the most practical and valuable method yet discovered of dealing simply and economically with an immense variety of metallurgical operations, which have hitherto been carried out under less favorable conditions.

In many cases where electric welding has been the only possible substitute for mechanical joints the blowpipe can now be more profitably employed, and in a large variety of work the Oxy-Acetylene Blowpipe method can be applied where electric welding is impractical. In actual use it is both cheaper and simpler than electric welding.

Autogenous welds can be effected by means of the Oxy-Acetylene Blowpipe, without any deleterious effect upon the metal. The heat is greater than that obtained from any other blowpipe.

The Linde Air Products Company desire to draw special attention to the fact that they are always willing to weld specimen pieces Free of Charge, and complete installations of the apparatus may be inspected at any time at any of the Company's works. Demonstrations and instruction in the use of the blowpipe will be given free of charge to those interested.

The Oxy-Acetylene system of blowpipe welding is employed in two systems, which may be described as the High and Low Pressure systems, respectively.

The first to be introduced was the High-pressure system, in which both gases are delivered to the blowpipe under pressure. Oxygen is supplied from an ordinary trade cylinder, and acetylene from a cylinder in which it is dissolved in a porous material soaked in acetone. Acetone is a liquid hydrocarbon, which has the property of absorbing twenty-five times its own volume of acetylene at atmospheric pressure, and it continues to do this for every atmosphere of pressure that is applied to the gas. It was soon found, however, that the cost of using dissolved acetylene in this way was so high as to be almost prohibitive, except under special conditions, and the high-pressure acetylene generator was then evolved to take the place of the tank of acetylene.

Owing, however, to the complications thus involved, and the high initial cost of the apparatus, the high-pressure blowpipe is now being generally superseded by the far more simple injector or low-pressure blowpipe.

A special feature of *the low-pressure blowpipe* is that it *may be employed with either high or low pressure generators with equal economy*, and it thus offers the highest flexibility. This is in particular of great convenience when circumstances warrant the use of both systems, and is an advantage not possessed by the older type of high-pressure blowpipe. Of the two systems, the low-pressure system of welding is by far the more extensively used, and at the present time many thousands of low-pressure blowpipes are in daily use. With this type of blowpipe only oxygen is required under pressure, so that acetylene may be taken from an ordinary generator of approved design. Such generators are preferably automatic, the absence of any positive feed mechanism, such as a clockwork arrangement, adding greatly to the efficiency and reliability of the process, whilst the whole apparatus is much simpler.

A great many misleading statements have been circulated from time to time to the effect that the oxygen consumption of a blowpipe is a factor dependent on the pressure of the acetylene supply, and that one type of blowpipe—the gas consumption being the same—gives better results than another. The absurdity of this will be readily appreciated. In a properly adjusted blowpipe the unit volume of acetylene requires a fixed proportion of oxygen for proper combustion, and develops a definite number of B. T. U. which is the heat available for welding. These values are absolutely independent of the type of blowpipe employed and cannot be varied, being defined and determined by the nature of the chemical reaction which takes place between the oxygen and acetylene. Any statement or guarantee to the contrary is impossible of fulfillment, and in direct opposition to the laws of chemistry.

Under normal working conditions with a properly regulated flame less than 1.5 cubic feet of oxygen are consumed for 1 cubic foot of acetylene.

The low-pressure injector blowpipe (Fouché patent) is supplied exclusively by The Linde Air Products Company, *who guarantee results.*

Acetylene Generator.

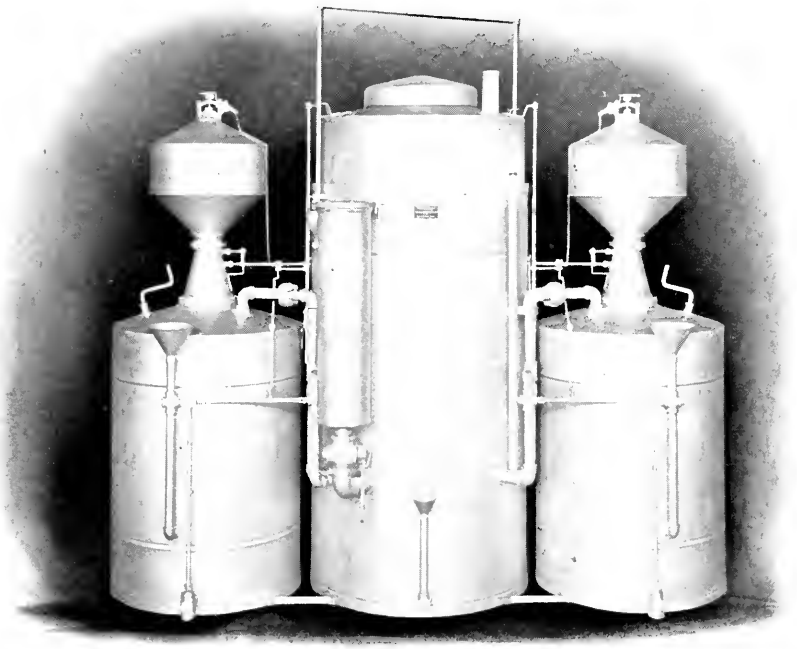
(Standard Stationary Type)

(FIGURE 1)

Figure 1 represents a standard generator of the low-pressure type, and is recommended for stationary use for general shop equipment.

Acetylene Generator.

(Duplex Stationary Type)



(FIGURE 2)

Figure 2 represents a Duplex Generator, which consists of two Acetylene Generators and one Gasometer. The advantage of this type of Generator over the single type is that in addition to using both Generators simultaneously each Generator can be operated independently of the other, allowing one to be used whilst the other is being charged.

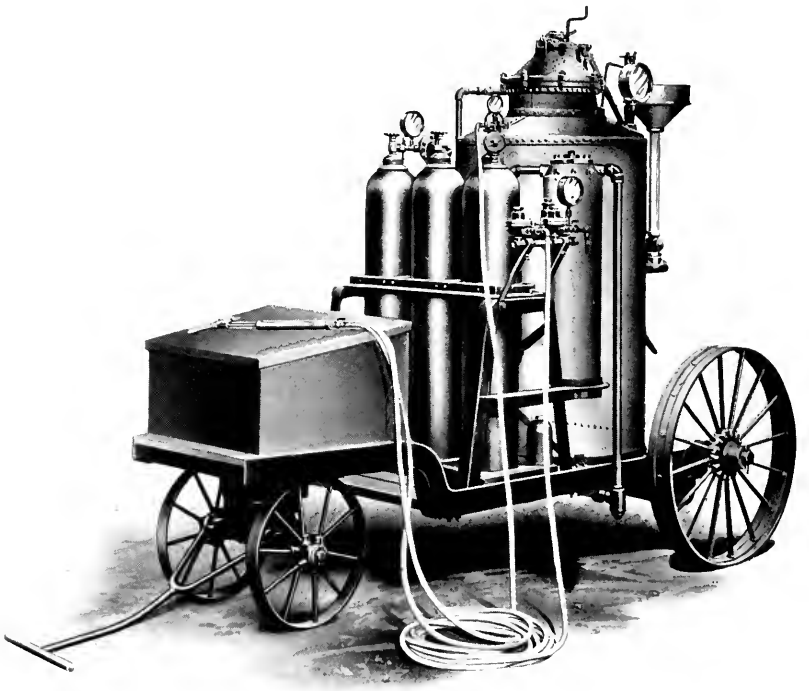
Acetylene Generator.

(Self-contained Type)

(FIGURE 3)

Where portability is required, and in certain other cases as a substitute for a tank of dissolved acetylene, the Company supply a high-pressure generator of the self-contained type, which is also entirely automatic in action. This generator is illustrated in Figure 3.

Complete Portable Welding Plant.



(FIGURE 4)

A complete self-contained and portable welding plant is illustrated in Figure 4.

It will thus be seen that Oxy-Acetylene welding apparatus with the low-pressure (injector) blowpipe is extremely flexible, and may be applied in the greatest possible number of different ways.

Size of Generators.

The size of the acetylene generator employed is a matter of much importance in relation to Oxy-Acetylene welding. It may be taken as a general axiom with regard to acetylene that the more rapidly heat is generated during decomposition of the carbide, the more impure will be the acetylene produced, and the worse the welding which will be effected with the gas.

If the decomposition of the carbide is effected with a restricted quantity of water, the heat evolved at the actual point of decomposition is so great that the acetylene itself becomes disassociated and reforms into various hydrocarbons.

This reaction is known as "polymerization," and separate hydrocarbons once formed cannot afterwards be eliminated without loss of acetylene—that gas being itself a hydrocarbon. Furthermore, these hydrocarbons require more oxygen for their proper combustion than does acetylene, and consequently when acetylene arrives at the blowpipe disassociated to some extent in the manner described, then the proportion of oxygen, which is correct for the proper combustion of that gas, becomes insufficient for the complete combustion of other hydrocarbons. On the other hand, if decomposition of the carbide is slow, there is no "polymerization," and these difficulties do not arise.

A generator of adequate proportions, together with a holder of ample size for the gas consumption required, is therefore a most important desideratum in the selection of an acetylene plant for Oxy-Acetylene welding. The generation of acetylene should be both slow and regular.

In a properly proportioned welding equipment, decomposition of the carbide takes place in such an excess of water that the heat evolved under ordinary working conditions is never sufficient to cause disassociation of the acetylene itself. Suitable acetylene generators are supplied by the Company in a great number of different sizes. They are supplied in three types (see pages 10-12).

Gas Pressure Gauge.

(FIGURE 5)

Price, ... each, $12.00

These Pressure Gauges are useful as a means of ascertaining the quantity of gas in cylinders.

To connect with cylinder valve screw the union on to the valve socket several turns. Then screw down the nipple in the union until it presses on the seat of the valve socket. Then tighten up the union by hand. The threads of the union being of different pitch, a metal-to-metal joint is made on the ball and cone principle with very little pressure and without the use of a gasket.

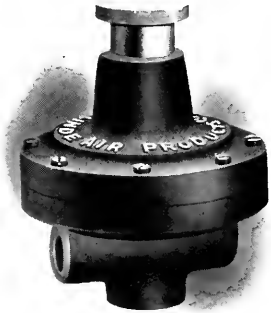
The gauge, as illustrated, is especially marked in atmospheres and cubic feet, and the contents of any cylinder may be readily calculated in the following manner:

The figures on outer ring indicate in atmospheres; 120 atmospheres being the pressure to which all cylinders are charged.

The figures on inner ring indicate the number of cubic feet of gas contained in a 10-foot cylinder. To calculate the quantity of gas contained in any cylinder, multiply the figure to which the needle points by the multiple of 10, thus: if the gauge is attached to a 50-foot cylinder, and the needle points to 6, then 6 x 5 equals 30 cubic feet, the quantity of gas in cylinder. (See Note on page 23.)

The gauge is fitted with safety checks in the stem to prevent a sudden rush of gas into the gauge tube when the cylinder valve is opened.

Line Regulator.



(Figure 6)

Price, ... each, $21.00

This regulator is for use with the high-pressure generator and is for regulating the flow of acetylene from the generator and delivers it at the desired pressure to the supply pipe. As the length of pipe is increased the pressure is to be increased accordingly. The adjustment is made by unscrewing the adjusting screw to reduce or by screwing it in to increase the pressure.

Blowpipe Regulator.

(FIGURE 7)

Price, ... each, $11.00

Figure 7 represents a regulator which is also for use with the high-pressure generator and regulates the flow of acetylene from the supply pipe to the blowpipe. Its adjustment is the same as for the line regulator.

The Fouché Welding Blowpipe.

Simplex No. 1

(Figure 8)

Simplex No. 2

(Figure 9)

Whilst preserving the characteristics of the original Fouché blowpipe, several new features have been introduced in this latest model, without departing from the injector principle which is the basis of the design and construction of the low-pressure blowpipe, and the reason of its reliability and economy.

The "Simplex" Blowpipe is so constructed that the gases entering it are controlled by a single lever, and the construction of the head is such that there is a minimum number of joints, thereby reducing wear and tear, and assuring long life.

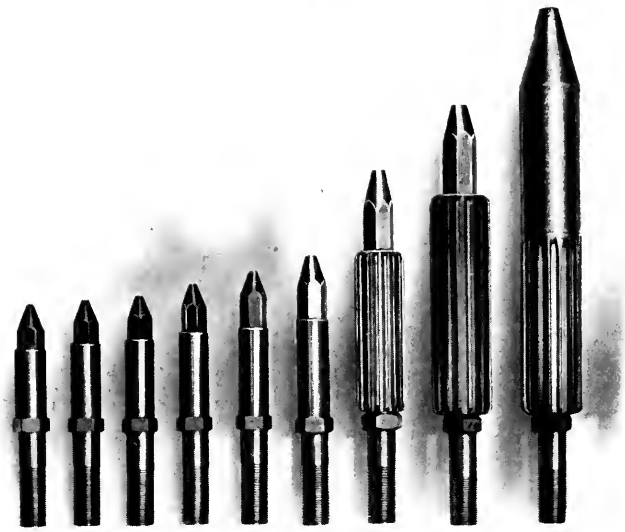
The "Simplex" Blowpipe is made in two different sizes. Each size is equipped with interchangeable welding heads as described on the following page. The "Simplex" Blowpipe is suitable for making any weld within the range of the process.

Size of Blowpipe	Standard Number and Sizes of Interchangeable Welding Heads	PRICE	
		With Standard Heads	Blowpipe Only, Without Heads
1	6 heads, Nos. 3– 8, inclusive	$57.50	$25.00
2	4 " " 8–15, "	75.00	35.00

For working instructions, see page 6.

(Figure 10)

A special drop-forged wrench is supplied free of charge with each blowpipe. Additional wrenches may be obtained at the price of 50 cents each.



(Figure 11)

Additional welding heads can be obtained at the following prices:

Size of Head	Working Oxygen Pressure Pounds Per Square Inch	Price
2	9	$7.50
3	10	5.00
4	11	5.00
5	12	5.00
6	14	5.00
7	16	5.00
8	19	7.50
10	21	10.00
12	25	10.00
15	30	12.50

This table also gives the average oxygen working pressures for the various sizes of Fouché blowpipes.

Intermediate sizes and also larger welding heads will be supplied to suit special conditions. Prices on application to the Company.

All blowpipes are accurately and carefully adjusted. The hole in the nozzle of the blowpipe must, under no circumstances, be enlarged.

The following table gives the approximate thickness of iron or steel plates for which each size of welding head is best adapted, so that Customers will be able to select a size of blowpipe suitable for their particular requirements. A general idea of the speed at which work of this nature can be done may also be gathered from this table, in which the approximate foot run welded per hour is given for various thicknesses of steel sheets and corresponding blowpipes. The quantities of gas consumed per hour by each of these blowpipes are also given, together with the approximate cost of welding per foot run.

Blowpipe No.	Approximate thickness of plate in inches	Foot Run Per Hour	Oxygen Consumption Cu. Ft. Per Hour	Acetylene Consumption Cu. Ft. Per Hour	Approximate Cost Per Foot Run, Including Labor
3	$\frac{3}{64}$	30	4	$2\frac{1}{2}$	$.012
4	$\frac{3}{32}$	21	6	$3\frac{3}{4}$	.021
5	$\frac{1}{8}$	15	10	6	.037
6	$\frac{3}{16}$	6	16	10	.125
7	$\frac{1}{4}$	4	25	15	.256
8	$\frac{3}{8}$	3	36	22	.456
10	$\frac{1}{2}$	2	45	28	.827

The above figures are average results obtained when working on cold plates and are conservative. By previously heating the piece to be welded in the neighborhood of the joint, the time and cost of making the weld may be reduced from 30 to 50 per cent. in the case of plates of $\frac{1}{4}$ inch thickness and upwards.

NOTE—For copper plates larger blowpipes are required than for steel plates of corresponding gauge.

Oxygen Constant Pressure Regulator for Welding.

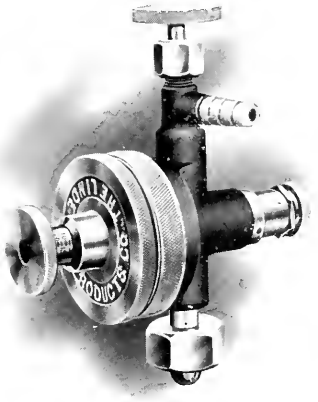
(Figure 12)

Price, ... $30.00

This is an automatic regulator which is especially recommended for blowpipe work. It will deliver oxygen, issuing from the cylinder, at a high and varying pressure, at any required low pressure, from zero up to 40 pounds per square inch. This latter pressure cannot be exceeded, as the safety valve, with which every regulator is fitted, then opens and releases the gas, the pressure being registered on the low-pressure gauge. The pressure can be adjusted by unscrewing the thumbscrew to reduce, or by screwing it in to increase the pressure. A cock is provided to control and shut off the supply of oxygen to the blowpipe.

When the blowpipe is not in use it is desirable to shut the oxygen cylinder valve also, in order to avoid all possibility of leakage. The pressure gauge registers the pressure of oxygen in the cylinder, and also enables the exact quantity of gas contained in the cylinder to be ascertained at any moment. (See note on page 23.)

Oxygen Constant Pressure Regulator for Welding.



(Figure 13)

Price, complete as shown, ... $15.00

This Regulator possesses the same properties as the one in the preceding illustration, but is not fitted with a pressure gauge.

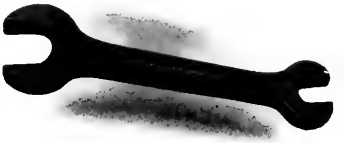
It can also be supplied with a special connection for use in conjunction with a tank of dissolved acetylene.

Price, complete with connection, ... $17.50

Note—*All cylinders are charged to 120 atmospheres and contain standard quantities of gas at this pressure (see table, page 30). When the regulator is attached to, say, a standard 100-foot cylinder, the pressure gauge will first register 120 atmospheres. If after use the pressure has been reduced to 60 atmospheres, the cylinder will then contain

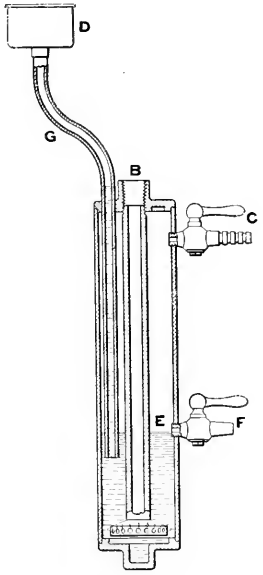
$$\frac{100 \times 60}{120} = 50 \text{ cubic feet of oxygen.}$$

A special drop-forged wrench is supplied free of charge with each regulator. Additional wrenches may be obtained at the price of 75 cents each.



(Figure 14)

Hydraulic Back-pressure Valve.



(Figure 15)

Price, ... $17.50

Although the use of the Hydraulic Back-pressure Valve is a desirable precaution it is in no sense connected with the working of the blowpipe, being principally intended to preclude the possibility of air at any time passing back into the acetylene generator whilst the apparatus is not in operation. Incidentally, it is an additional advantage that, should the blowpipe nozzle at any time become choked, the back pressure thus caused on the surface of the water in the chamber will break the seal at E; should the oxygen supply remain unchecked, when both gases will escape into the atmosphere, until the cocks at B and C are closed. In this way oxygen can never penetrate the acetylene supply pipe beyond the cock B of the Hydraulic Back-pressure Valve.

The action of the Hydraulic Back-pressure Valve is apparent from the diagram (Figure 15). The cock on the acetylene pipe from the gas holder is connected to the inlet at B, and the acetylene pipe leading to the blowpipe is connected to the outlet C. D is a priming cup through which water can be poured into the chamber until it overflows at the cock F. The cock on the service line at B must be closed whilst the chamber is being filled with water. When water shows at the cock F, it must be closed and the cock B opened. The valve is then in working order.

The pipe G, leading from below the seal at E to the priming cup, is made of sufficient length to hold a column of water equal to the pressure in the acetylene holder, which would be equal to not less than 12 inches of water, and in no case should exceed 20 inches.

In cases where two or more blowpipes are worked from the same acetylene supply pipe, a separate back-pressure valve should be employed for each welding station.

Table giving the approximate internal diameter in inches of pipe required between the acetylene apparatus and the hydraulic back-pressure valve.

(Low-pressure System)

Quantity of Acetylene Required Per Hour in Cubic Feet		5	10	25	50	75	100
Distance in feet between acetylene apparatus and hydraulic back-pressure valve	50	1	1	1	1¼	1½	2
	100	1	1	1¼	1½	2	2
	200	1	1¼	1¼	2	2	2½
	500	1¼	1¼	1½	2	2½	2½
	1000	1¼	1½	2	2½	2½	3
	2000	1½	1½	2	2½	3	3½
	3000	1½	2	2½	3	3½	4

With High-pressure Generators, or Dissolved Acetylene, These Sizes may be Considerably Reduced.

Instructions for Using the Blowpipe.

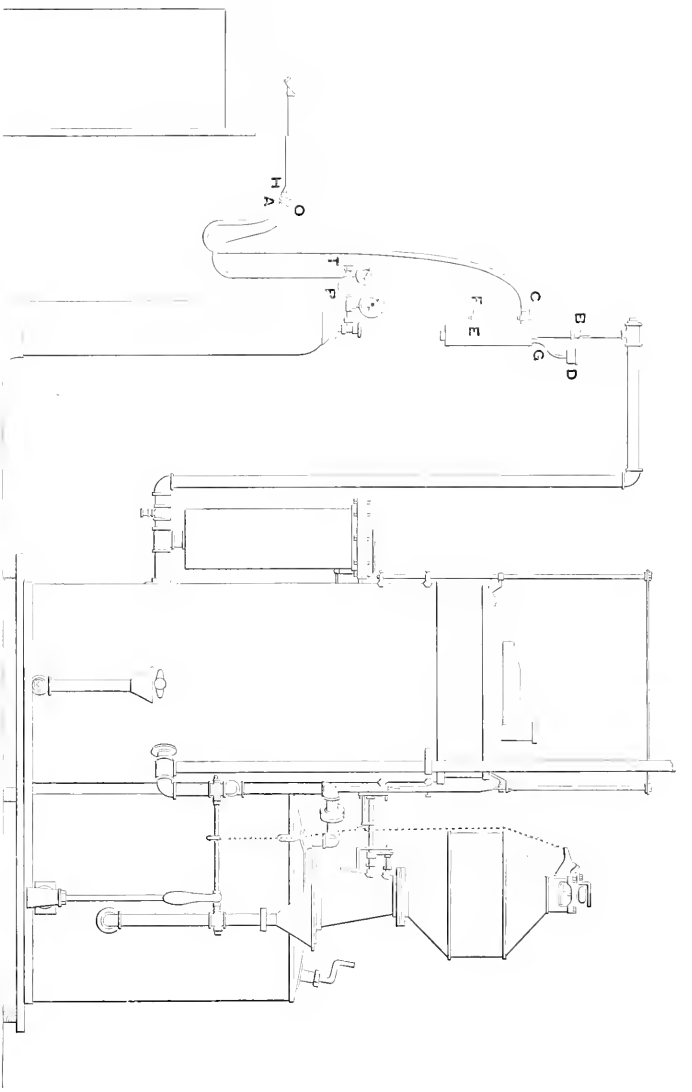
The annexed illustration represents, diagramatically, a complete Oxy-Acetylene Blowpipe installation, with the exception of the acetylene generator and holder, which may be placed in any suitable position and at any convenient distance from the blowpipe apparatus.

In the diagram (Figure 16) B is a cock connecting the inlet nipple of the hydraulic back-pressure valve (see pages 24 and 25) with the acetylene supply pipe from the acetylene holder. The blowpipe is connected at A by means of an ordinary stout rubber tube with the outlet C of the hydraulic back-pressure valve which forms the acetylene supply pipe of the blowpipe.

The blowpipe is connected at O by means of a stout rubber tube with the outlet cock T of the oxygen pressure regulator (see pages 22, 23), which is attached, as shown, to the valve on the oxygen cylinder. This pipe conveys the oxygen supply to the blowpipe, and should be securely attached, as it is subject to pressures varying from 10 pounds to 30 pounds per square inch.

The hydraulic back-pressure valve having been previously charged with water in accordance with the instructions on pages 24, 25, and the gas regulator securely attached to the oxygen cylinder, the blowpipe is ready for use.

In order to commence work, the outlet cock T should be first opened by unscrewing it about two complete turns, but not more than four turns. The cylinder valve is now slowly and carefully opened by turning the small handwheel. Then by means of the adjustable screwed socket P of the constant pressure regulator, set the pressure of the oxygen to the correct working pressure (see table on page 20). This pressure is indicated on the small gauge. Both the acetylene and oxygen gases are shut off when the lever H is pointed downwards if the blowpipe is held in a horizontal position. Now turn the lever H in the direction of the rotation of the hands of a clock and when acetylene comes from the nozzle of the blowpipe ignite the jet, continue to turn the lever H until both acetylene and oxygen issue from the nozzle, thereby giving the correctly adjusted flame. This is correct when the small luminous cone of flame at the nozzle of the blowpipe shows a sharply defined outline.



(Figure 16)

Notes on the Practical Operation of the Blowpipe.

The working pressure for oxygen as indicated by the numerals on the dial of the low-pressure gauge of the regulator should not be too rigidly adhered to. Even in blowpipes of the same size, the conditions must vary somewhat, and a little practical experience will soon indicate the most favorable working conditions.

If the flame is not properly regulated it may fire back and become extinguished. In this case the gases should be shut off for a few seconds when the flame may be re-ignited.

When work is carried on continuously for the entire time without interruption, the nozzle of the blowpipe becomes warm, and it will be found necessary to occasionally slightly increase the acetylene supply. It is advantageous, from time to time, to cool the end of the blowpipe by immersing it in a bucket of water.

No reamer or other sharp instrument should be used in the nozzle of the blowpipe (see page 20). If the hole in the nozzle gets obstructed at any time through beads of iron being splashed into it or from any other cause, it should be cleaned with a wire brush or a piece of soft iron wire.

On closing work temporarily the lever H should be turned round still further until both gases are turned off, then the outlet cock T may be shut.

When work is completely stopped, the oxygen cylinder should also be shut off by closing the valve, and the pressure thus released from the regulator (see page 22).

As regards the cost of the process much depends on the nature of the work and the capacity and skill of the workman, but it may be stated generally that the system compares very favorably with the cost of riveting or brazing. It is not claimed that the system will entirely supersede ordinary forge welding or even electric welding, but the blowpipe is such a clean, convenient, and portable tool that it enables a large variety of difficult and complicated welding to be done "in situ" where riveting or brazed joints would otherwise be necessary. It, therefore, greatly extends the scope of welding.

As an example of the quality of the work, it may be stated that plates of iron or steel, in thickness from 20-gauge upwards, when welded together by the Fouché Blowpipe have proved stronger at the joint than in the body of the plate. Tests of bars of iron fused together by this system have given an ultimate tensile strength of over 29 tons per square inch at the joint.

The speed with which the welding can be done varies to a considerable extent with the character of the job, the capacity of the workman and his skill in handling the blowpipe. It may, however, be stated that any ordinary workman of average intelligence very quickly becomes proficient in the application of this method.

The Company will at any time be glad to weld samples of work free of charge, and engineers, manufacturers, and others interested are cordially invited to send samples for this purpose. All such samples will be promptly dealt with and returned to the sender for inspection. If desired, arrangements can be made for the sender to witness the treatment of his own samples of work.

Oxygen.

SPECIAL INDUSTRIAL RATES.

Oxygen for use with the Fouché Blowpipe can be obtained in the Company's cylinders at the price of 2 cents per cubic foot.

These cylinders, which will each contain 100 cubic feet, will remain the property of the Company and will be loaned free of charge, subject to the terms and conditions here below.

Oxygen for use with the Fouché Blowpipe in the Customers' cylinders can be obtained at the price of 1.5 cents per cubic foot; therefore, Customers who are constant users of compressed gases will find it more economical and convenient to purchase their own cylinders, sending them to the works of the Company to be refilled when necessary.

Reductions on the above prices will be made in cases where very large quantities of oxygen for welding are required at regular intervals.

Rent.

Rent is charged after the first month, as per particulars below, on all cylinders lent out by the Company. In case a Customer, having incurred a rent charge on a cylinder, decides to purchase the cylinder, according to the circumstances, the Company may remit a portion or all of the charges for rent.

Contents in Cubic Feet	Approximate Weight in Pounds	Price of Cylinder with Valve	Rent Per Week After the First Month
5*	6	$6.50	
25	28½	8.50	$0.50
50	62	12.00	.75
100	132	20.00	1.00

*This size of cylinder cannot be hired.

Hired cylinders should be returned to the Company whenever they are finished with to avoid rent charges accumulating. A label bearing the Customer's name should always be attached to a cylinder when it is returned to the Company's works.

The Company allows no credit for return of gas, as, in accordance with their regulations, cylinders which have been used are always emptied before being refilled. It is, therefore, well to note that gas returned is gas wasted. Oxygen never deteriorates by being kept in cylinders.

Cylinders.

The cylinders in which oxygen is supplied by the Company at a pressure of 120 atmospheres are of seamless steel, and are manufactured under careful supervision, and in accordance with the Company's regulations and to their own specifications (see page 6). These cylinders are made in various sizes to suit the requirements of individual Customers. A screwed cap is fitted to all cylinders, except the smallest size, to protect the valve, which is of special construction and requires no key nor spanner to manipulate it. The valve is capable of very fine adjustment by means of the small handwheel.

No cylinders, other than those supplied by the Company, can be accepted for refilling. A special register of all such cylinders is kept at the works.

Numbering of Cylinders.

All cylinders, whether belonging to the Company or to a Customer, are numbered and stamped by the Company in accordance with their own test books, and entered in the Company's cylinder register. This plan is adopted by the Company in order to retain the life record of each cylinder passing through their hands.

Testing and Annealing Marks.

The Company beg to draw the attention of their Customers to their cylinder specification, testing and annealing marks as below. All cylinders filled by the Company (whether their own or their Customers) bear one or more of these marks. As a guarantee that the cylinder has been annealed, tested and proved sound, in accordance with the Company's regulations, after being manufactured under careful supervision to the Company's specifications, the mark will be found stamped on the shoulder.

Proving of Cylinders.

Re-annealing of cylinders takes place at intervals not exceeding about four years. The annealing mark of the Company is 

The charges for annealing are as under:

Cylinders up to and including 50 cubic feet capacity, each,	$2.50
Cylinders over 50 cubic feet capacity,	3.00

All cylinders are tested hydraulically after annealing to a pressure of 3,600 pounds per square inch and afterwards registered. The Company retest all cylinders periodically, the charges for which are as follows:

100-cubic feet size,	$2.50 each.
50 " " "	2.00 "
25 " " "	
5 " " "	

a periodical retesting being necessary as much in the interest of the Customer as of the Company. The above charges, which are payable in advance, are exclusive of cost of freight to and from the works. The test mark of the Company is 

No cylinders will be refilled by the Company without:

a. Retesting, if a greater period than four years has elapsed since the date of the last test, and

b. Re-annealing and retesting, if a greater period than four years has elapsed since the last date of annealing.

The Company will not be held liable for any cylinders which fail to stand the test after use or after re-annealing.

For identification purposes all oxygen cylinders are painted red.

Painting.

For the convenience of Customers owning cylinders the Company repaint them when necessary if desired, at the following prices:

100-cubic feet size,	$0.50 each.
50 " " "	.35 "
25 " " "	.25 "
5 " " "	.15 "

Fittings and Sundries.

Special high-pressure hosepipe for attachment to the blowpipes and regulators will be supplied at 20 cents per foot, net.

Owing to the intensity of the illumination created at the base of the Oxy-Acetylene flame by the combustion of the carbon, it is necessary to protect the eyes when using the blowpipe by means of darkened glass spectacles. These the Company will be glad to supply to Customers at $1.50 each per pair, net.

The Company not being makers of Pressure Gauges do not guarantee these articles in any respect.

Welding Cast Iron.

Feroflux is supplied by the Company in tins, each containing about 10 pounds, at the price of $10.00 per tin. Full instructions are supplied with every shipment.

Welding sticks, consisting of a special cast-iron alloy, which is used in conjunction with feroflux for welding cast iron, are supplied by the Company at 25 cents per pound.

Welding Steel.

Norway Iron Wire can be obtained in two gauges:

No. 8, B. & S., for heavy work, . . $0.12 per pound.
" 16, " " light " . . .14 " "

The above prices include packing and delivery at the works at Buffalo.

For information in regard to the production of oxygen, write for circular B.

The Company will at all times be glad to submit tenders for any special apparatus required by Customers for the generation of high temperatures in conjunction with the use of oxygen.

The prices in this catalogue are subject to alteration without notice, and supersede all previous prices.

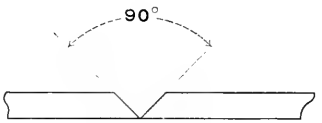
Welding Notes.

It should be borne in mind that notwithstanding its simplicity and the ease with which the Oxy-Acetylene Blowpipe can be handled, it is only by proper manipulation that satisfactory results can be obtained. Attention is therefore particularly drawn to the following notes:

1. The proper regulation of the flame should be carefully attended to. Excess of acetylene will give a reducing flame, whilst too much oxygen will burn the work. The flame will be neutral in character if adjusted in accordance with the instructions on page 26. If the weld has a fine, spongy appearance, this is certain evidence of the fact that the flame is of an oxidizing nature, due to an insufficient supply of acetylene, and that the work is burnt.

2. An autogenous weld is a "butt-weld." Only in the case of comparatively thin copper tube should the parts be "lapped."

3. Careful attention must be paid to the preparation of the parts to be welded. In the case of wrought iron and steel, the pieces at the weld must generally be champfered off at an angle of 45 degrees, so as to enable the flame to come into direct contact with the whole of the surfaces to be united, thus:



(Figure 17)

The groove formed by the champfered edges is filled by fusing in steel wire whilst maintaining the bottom and sides in a state of fusion. The wire must not be fused in unless the bottom and sides of the groove are also in a state of fusion. This is the secret of successful welding.

4. Commence at the nearest point and work "away from the person." The blowpipe should be maintained at a uniform distance —about $\frac{1}{32}$ inch with the smallest size, to about $\frac{1}{4}$ inch with the largest size—from the work, and advanced slowly and regularly. A slight side movement or oscillation of the nozzle will be found useful, particularly for "finishing."

5. Where the maximum strength obtainable is required it is desirable, if possible, to weld from both sides, thus:

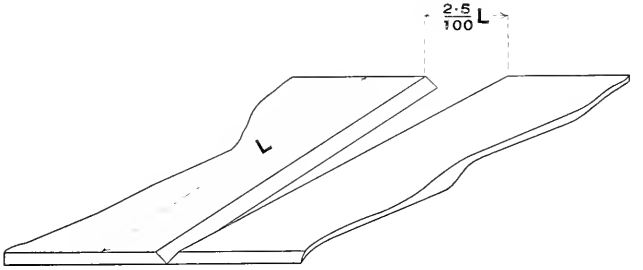
(Figure 18)

This is particularly advantageous with heavy work as it enables a much smaller blowpipe to be used than is necessary if the welding all be done from one side. The amount of filling is in this case only one-half what it would otherwise be, and the cost of the work and time required are correspondingly reduced.

6. For "filling" use open hearth soft steel or soft Norway iron wire when welding mild steel. Nothing heavier than about No. 14 gauge should be employed. For heavy work, two, three or more pieces of No. 14 gauge may be twisted together. For light work No. 20 gauge will be found very useful.

7. In making long welds it will be observed that the edges to be united have a great tendency to overlap as soon as welding is commenced. This "creeping" is due to the increased expansion of the edges being welded owing to the intense local heat of the flame.

Instead of attempting to overcome this by clamping or pinning the pieces, allowance should be made for it in setting the pieces, thus:



(Figure 19)

The exact amount of the opening required will vary somewhat with the size, thickness and nature of the material being welded, but, generally speaking, the ends away from the joint where the weld commences should open a distance equal to about $2\frac{1}{2}$ per cent. of the total length of the weld. Then as the weld progresses the edges of the pieces will gradually come together.

8. In welding fractured castings it is not always necessary to champfer the edges of the pieces to be united. It is, however, essential that the material should be "run" right through, and this can be done by means of the blowpipe. For welding cast iron Feroflux is necessary, and the use as a "filler" of special cast rods, rich in silicon, is also recommended, as only in this way can "Bessemerization" of the casting be prevented, and a "finished" weld obtained which is soft and may be easily machined (see page 33).

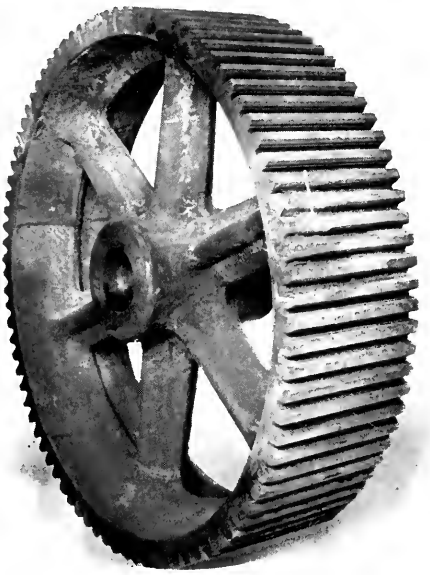
In dealing with complicated castings, such as cylinders of automobile engines, precautions have to be taken to prevent new fractures developing from expansion and contraction owing to internal strains set up by the intensity of the local heat. In such cases it is frequently desirable to pack the casting with molders' sand, covering over the openings with a little fire clay to prevent the sand from falling out. (Asbestos wool may be used as a substitute for this if more convenient.) The casting should then be heated up in any convenient manner to a dull red heat and the blowpipe applied when it is in this condition. After completing the weld the casting should be allowed to cool off very slowly. From 12 to 20 hours should be allowed if this is possible.

Apart from preheating, for the reason referred to in the previous notes, preheating is also valuable in that the time and cost of making the weld may be reduced from 30 to 50 per cent. by previously heating the piece to be welded in the neighborhood of the joint.

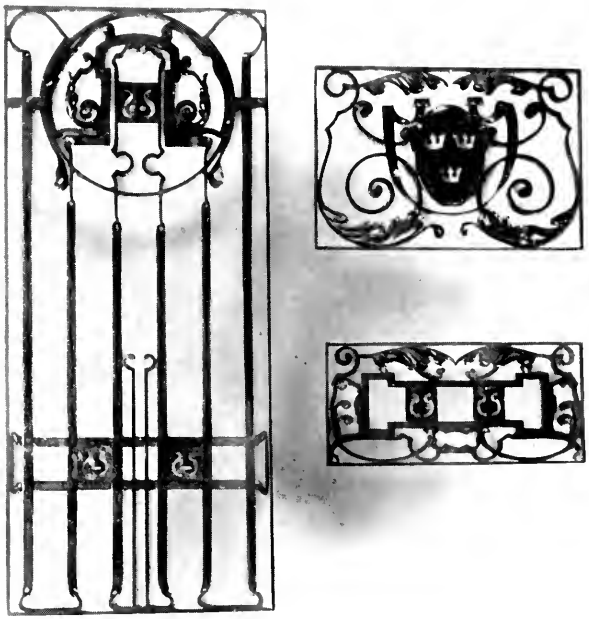
Some "Oxy-Acetylene" Repairs.

One of the most important features of this method of welding is the remarkable success with which it may be applied to repair work—more particularly in repairing castings. There seems to be practically no limitation to its use in this way. No casting is too heavy for it and none too light.

The following illustrations have been selected at random from a great many other photographs of work which has actually been carried out by the Oxy-Acetylene Blowpipe.

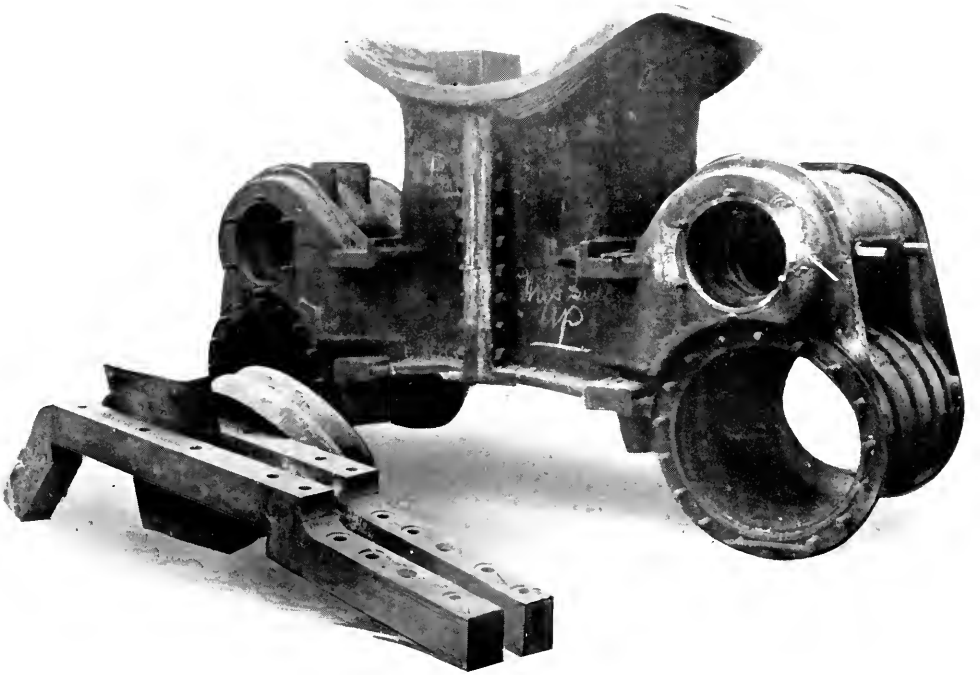


CAST STEEL PINION, WEIGHT, 4,000 LBS., REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



EXAMPLES OF ORNAMENTAL IRONWORK WELDED BY MEANS OF THE OXY-ACETYLENE BLOWPIPE.

SIDE ROD OF LOCOMOTIVE REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



LOCOMOTIVE CYLINDER.
REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.

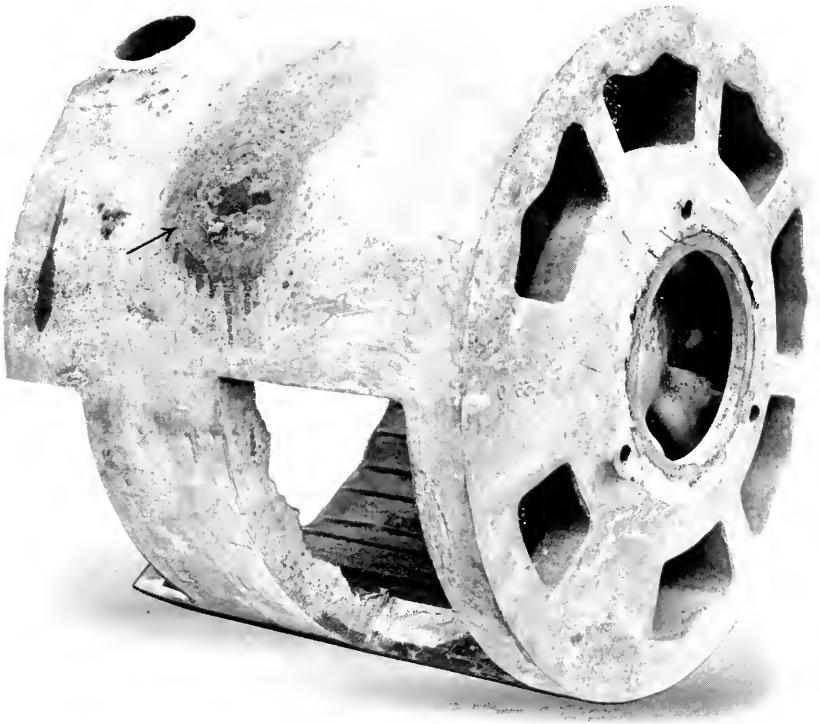
EXAMPLES OF ORNAMENTAL IRONWORK WELDED BY MEANS OF THE OXY-ACETYLENE BLOWPIPE.

HIGH-PRESSURE STEAM DRYER.

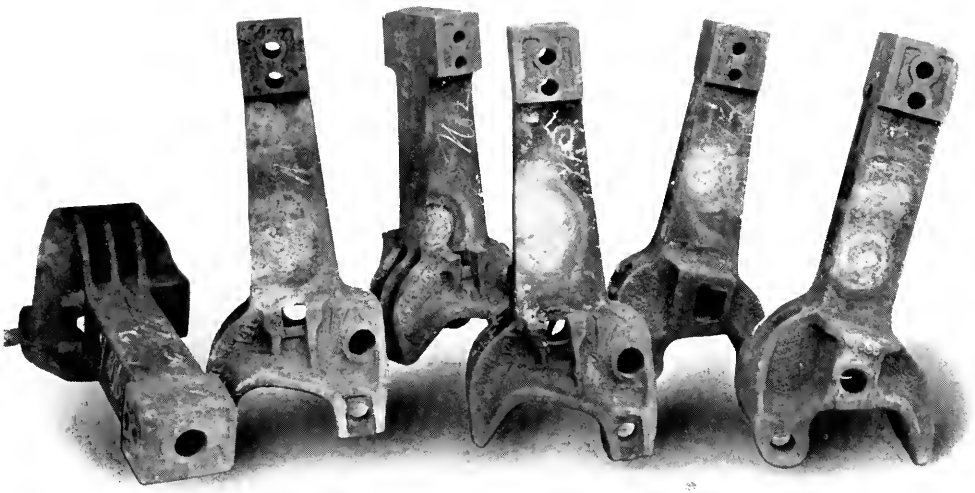
ALL PARTS WELDED BY THE OXY-ACETYLENE BLOWPIPE AND TESTED TO 600 LBS. PER SQUARE INCH HYDRAULIC PRESSURE.

ORNAMENTAL GRILLE WELDED BY THE OXY-ACETYLENE BLOW-PIPE CONSISTING OF 422 INDIVIDUAL PIECES.
NO HOLES DRILLED. NO RIVETS USED.

TRANSFORMER CASE WITH TUBES WELDED IN BY THE OXY-ACETYLENE BLOWPIPE.



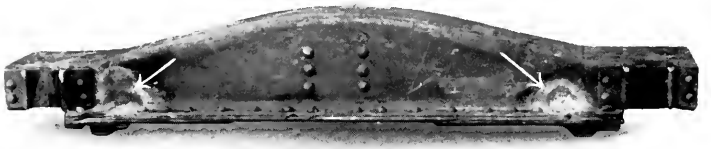
COLD SHUTS IN CAST-IRON FIRE POT REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



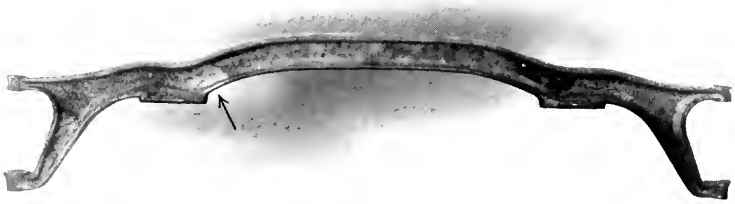
STEEL COUPLERS REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.
(BLOW-HOLES FILLED.)

CAST-IRON CYLINDERS AND MALLEABLE IRON ELBOWS REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.

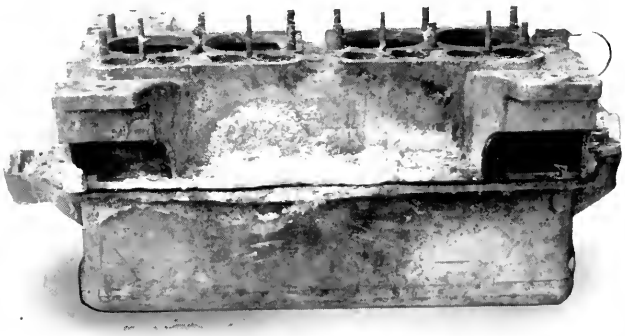
(FLANGES BUILT UP AND WELDED.)



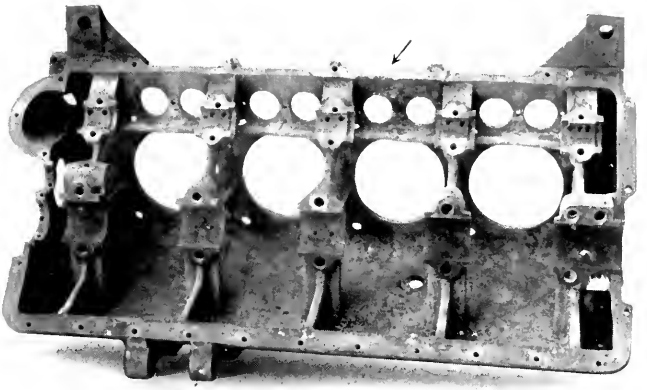
STEEL CAR BOLSTER REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



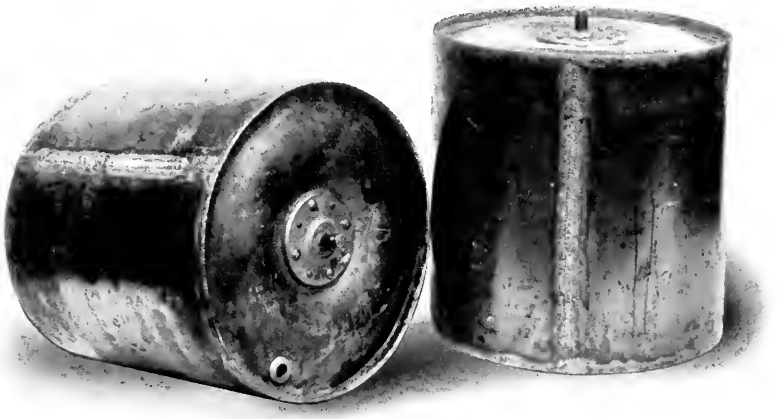
DROP FORGED AUTOMOBILE AXLE REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



ALUMINUM CRANK CASE REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



ALUMINUM CRANK CASE REPAIRED BY THE OXY-ACETYLENE BLOWPIPE.



LIGHT STEEL DRUMS WELDED BY THE OXY-ACETYLENE BLOWPIPE.