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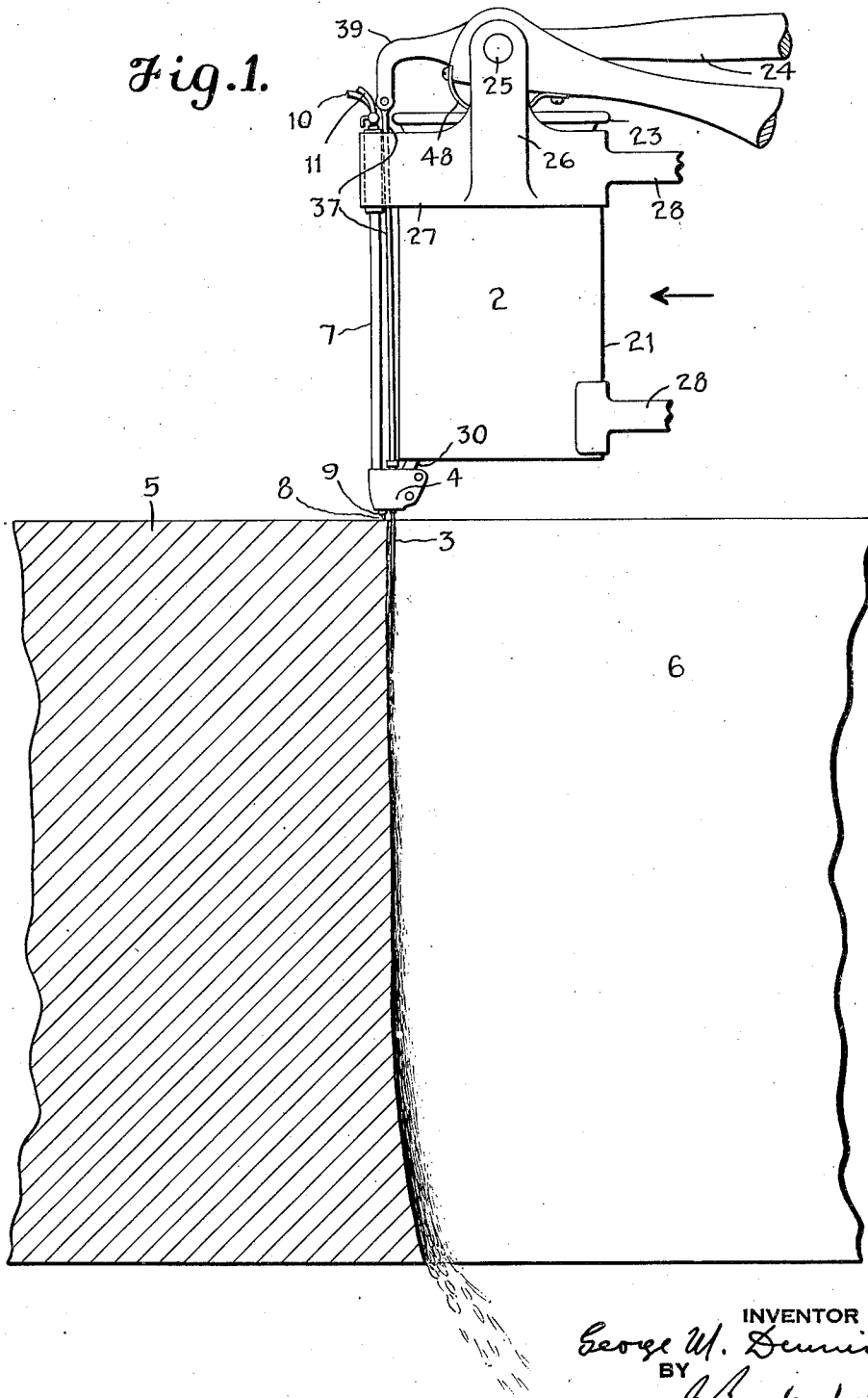
G. M. DEMING

2,094,641

PROCESS FOR CUTTING METALS WITH OXYGEN

Filed June 5, 1935

3 Sheets-Sheet 1



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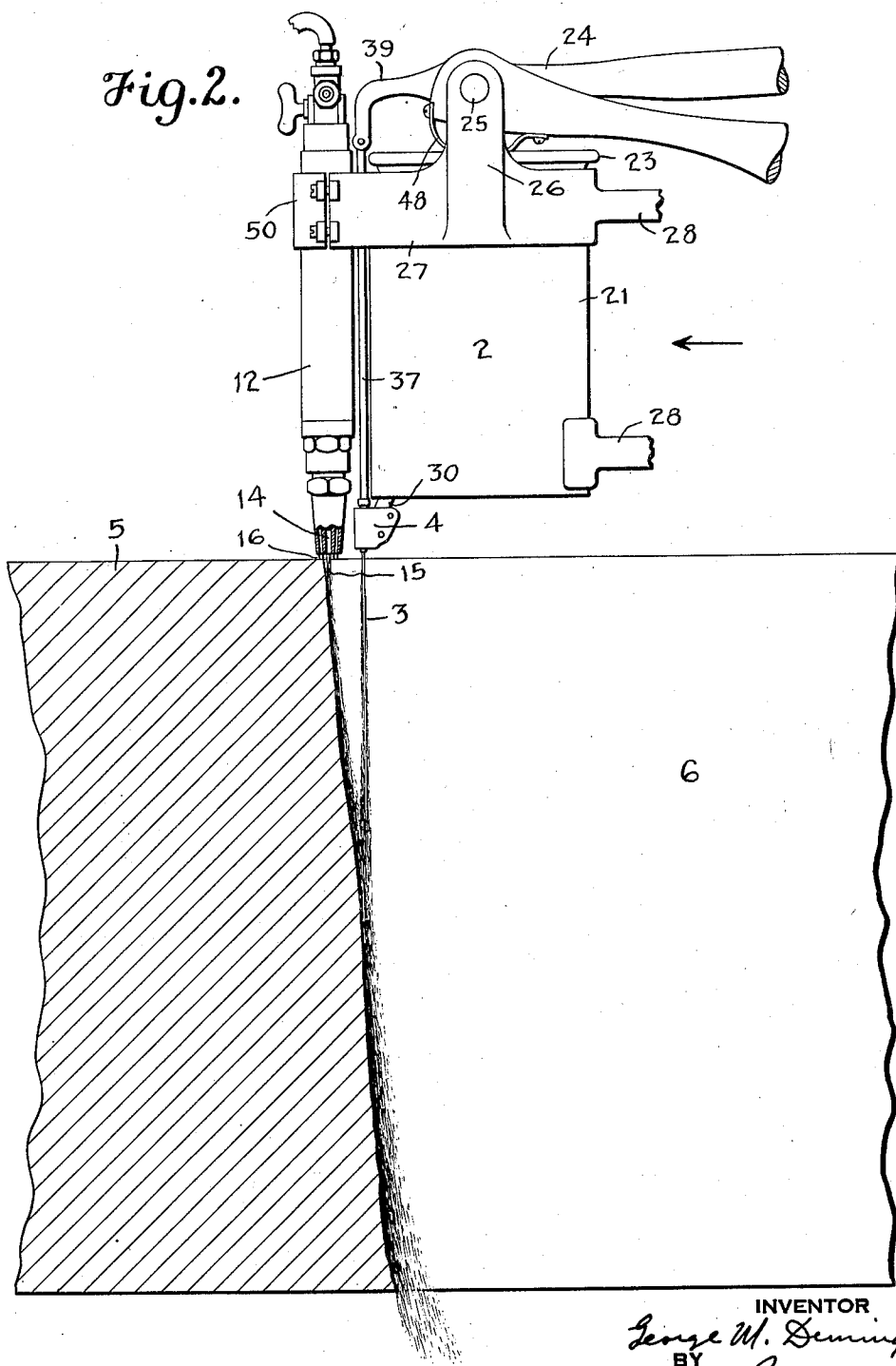
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PROCESS FOR CUTTING METALS WITH OXYGEN

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3 Sheets-Sheet 2



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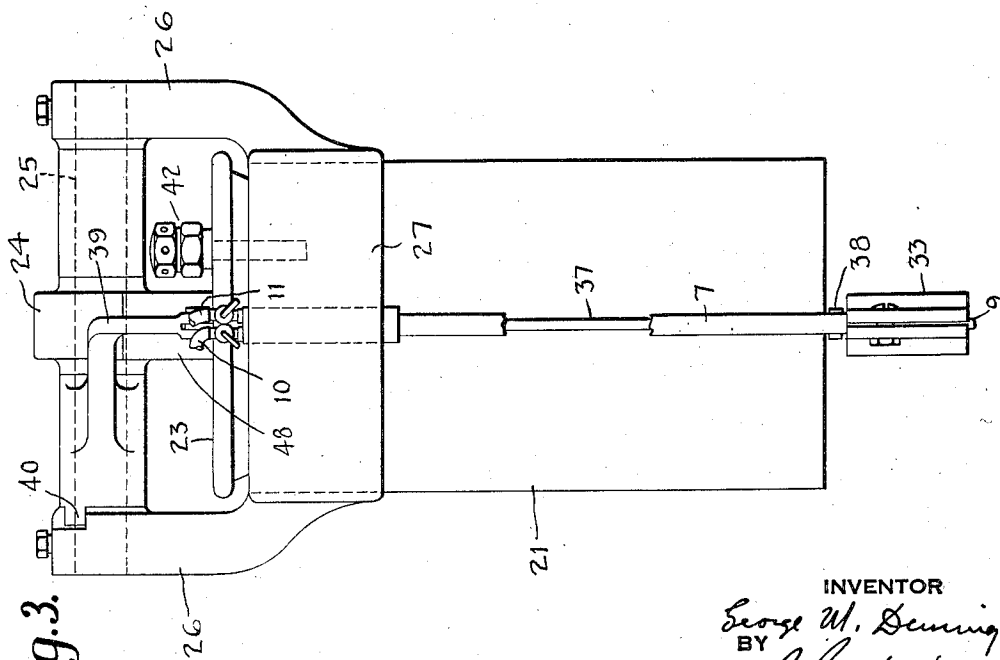
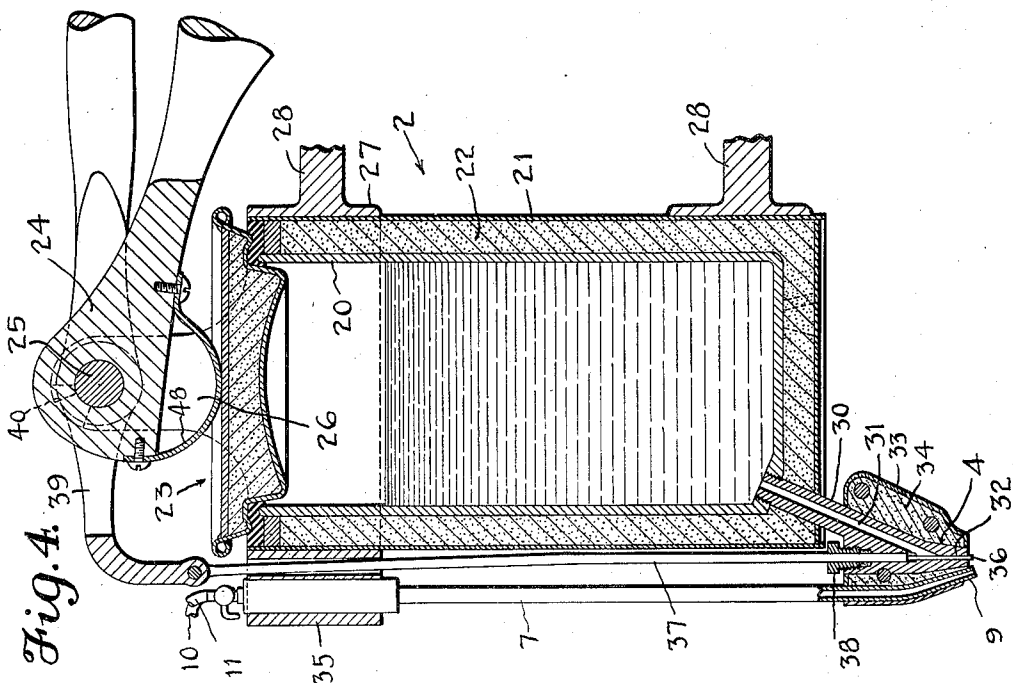
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PROCESS FOR CUTTING METALS WITH OXYGEN

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3 Sheets-Sheet 3



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PROCESS FOR CUTTING METALS WITH OXYGEN

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Application June 5, 1935, Serial No. 25,009

10 Claims. (Cl. 148—9)

In the known practice of cutting metal with oxygen, a portion of the metal is usually brought to kindling temperature by one or more preheating flames and a jet of gaseous oxygen is directed against the heated spot. This jet, by rapid oxidation and some mechanical disintegration of the metal, makes an opening, which may be extended to form a kerf, or severance slot, by displacing the jet laterally to itself at a suitable rate of speed, or by moving the metal relatively to the cutting jet, which amounts to the same thing. This manner of cutting metal has great utility.

The object of this invention is greatly to increase the efficiency of oxygen cutting, and also to make it possible to cut through much larger thicknesses than it has been possible to cut heretofore. The invention is based on the conception and discovery, contrary to what would be expected, that metal can be cut advantageously with oxygen in the liquid state. In carrying out the invention liquid oxygen only may be used for the cutting stream or streams, or separate cutting streams of gaseous oxygen and liquid oxygen may be used in conjunction.

In the accompanying drawings forming part hereof and illustrating the process and forms of apparatus for carrying the same into effect:

Fig. 1 is a view illustrating the cutting of a thick piece of metal in accordance with one form of execution of the invention, the apparatus being shown in side elevation and the work in section;

Fig. 2 is a similar view illustrating cutting performed in accordance with another form of the process;

Fig. 3 is a front elevation of the apparatus shown in Fig. 1, a portion of the preheater torch being broken out; and

Fig. 4 is a vertical section taken through this apparatus, looking at right angles to Fig. 3.

Referring to Fig. 1, a supply of liquid oxygen is held in a heat-insulated reservoir 2. A stream 3 of the liquid oxygen is delivered through a cutting orifice in an outlet portion 4 connected with the lower part of the interior of the reservoir. This cutting orifice portion may be termed a nozzle, without implying any particular form which it may take. The stream 3 is shown attacking the body of metal 5 and cutting a kerf 6 therein. The direction of displacement of the apparatus and of the cutting stream to advance the cut is indicated by the arrow. If the apparatus remained stationary, the work would be moved in the reverse direction, to the same effect.

Associated with the cutting orifice there is a means 7 for applying one or more flame jets 8, to bring the metal to kindling temperature in the first instance and to aid in the execution of the cut. This preheater has a burner tip 9, connections 10 and 11 to receive oxygen and combustible gas, and suitable mixing provisions (not shown).

In Fig. 2 a cutting torch 12 is disposed somewhat ahead of the liquid oxygen orifice, this torch constituting a means for delivering through an orifice 14 a cutting stream 15 of gaseous oxygen. If an ordinary cutting torch is used it will include provisions for delivering one or more preheating flames 16; and the preheating means 7 need not be employed.

By using liquid oxygen and relying upon either the outer and gaseous envelope of the liquid stream or upon a separate gaseous oxygen stream to open the kerf, liquid oxygen, that is oxygen of high concentration and purity, may be delivered deep into the kerf. The cross-section of the liquid cutting stream is exceedingly small because the density of liquid oxygen is about eight hundred times that of gaseous oxygen. Because of its small cross-section, because of the much lower velocities of discharge that are appropriate for cutting with liquid oxygen, which velocities may be of the order of ten to twenty feet per second, or more, and because a smoothly bounded liquid stream is more readily maintained than a smoothly bounded gaseous stream, the pollution of the stream from the surrounding atmosphere, from preheating combustion gases and from the products of combustion of the metal is much less than in cutting with gaseous oxygen in the regular way. Since the time of delivery from the nozzle to the deeper portions of the cut is only a matter of a small fraction of a second, evaporation need not be so rapid that the liquid state will not persist at a considerable depth in the cut. This is particularly true if the process is carried out in the manner illustrated in Fig. 2 where the gaseous oxygen stream opens the upper portion of the cut while the oxygen of the liquid stream is effective within the kerf and insures completion of the cut in the lower regions. In any case the use of a liquid oxygen stream for cutting makes it possible to deliver purer oxygen into the cut and to have less pollution of the oxygen at any given depth than would exist in cutting with gaseous oxygen as ordinarily. From this it follows that greater thicknesses of metal can be cut.

Apparatus for use in the process is shown in more detail in Figs. 3 and 4.

The reservoir 2 comprises an inner vessel 20 holding the liquid oxygen, an outer shell 21, heat insulating material 22 between these walls, a heat insulated cover 23, and a cam lever 24 for locking the cover tightly closed, this locking lever being fulcrumed on a shaft 25 carried by brackets 26 on a ring 27 secured to the outer shell 21. Mounting brackets 28, which are shown broken away, serve to support the apparatus on a suitable feed mechanism (not shown) by which it can be moved in the desired direction of severance; or the apparatus may be supported in a stationary manner and the work be moved beneath it.

The liquid oxygen cutting nozzle 4 has a stem 30 secured in an opening in the bottom of the inner vessel, this stem having a passage 31 which communicates at an angle with the delivery orifice 32. The cutting nozzle and the preheating tip 9 are surrounded by a jacket 33 containing heat-insulating material 34. The preheater torch may be supported on the outer shell of the liquid oxygen reservoir by a holder 35.

The walls of the cutting orifice 32 are parallel, and in this orifice, when the outlet is closed, there is a valve needle 36, the sides of which are straight and parallel. The valve needle is connected to or formed on a rod 37, which passes through a stuffing-box 38 in the top of the nozzle 4 to the top of the reservoir, where it is pivoted to a valve lever 39 fulcrumed on the shaft 25. A limiting lug 40 on the fulcrum portion of the valve lever determines the extent of movement in opening and closing the cutting valve.

The relations are such that when the valve is closed it occupies the delivery orifice 32, substantially filling it to the exit. In fact, as shown, the needle then projects somewhat beyond the outlet end of the orifice; and the end of the needle is cut off square (not tapered) or is otherwise formed so that in the act of closing it will shear off any excess rime that may have formed in the delivery orifice. When the orifice is closed any slight clearance between the valve needle and the walls of the orifice is quickly sealed by rime. The smooth surface of the needle results in the formation and preservation of a smooth lining for the cutting orifice. When the cutting valve is opened the needle 36 is withdrawn rearward or upward in the orifice 32 to a position in which the extremity of the needle clears the junction between the orifice and the passage 31.

Means are provided for maintaining a constant pressure inside the liquid oxygen reservoir, in order to discharge the liquid oxygen stream 3 at the requisite linear velocity. The pressure of the oxygen gas or vapor evolved from the liquid oxygen in the reservoir will itself serve as the operating pressure, and this pressure can be held to a definite value by a pressure relief valve 42, which may be adjustable or which may be replaced by other valves set for different pressures, if it is desired to vary the linear velocity of the liquid cutting stream.

To guard against excessive or hazardous pres-

sure developing in the liquid oxygen reservoir, if not taken care of by the relief valve 42, an emergency vent may be provided. To that end the cover locking lever 24 has a cam portion consisting of a heavy spring 43, which is rigid enough for all usual conditions but will yield when required to permit the cover to lift under excessive internal pressure.

The apparatus shown in Fig. 2 is similar to that of Figs. 1, 3 and 4 except that the preheater torch 7 is not present and a gaseous oxygen cutting torch 12 is associated with the liquid oxygen cutting apparatus. This torch is shown mounted on the reservoir in a holder 50, which may be made adjustable.

I claim:

1. The process which comprises cutting a kerf through metal at kindling temperature by means of a stream of liquid oxygen.

2. The improvement in the art of cutting an opening or kerf in metal, at kindling temperature, by means of oxygen, which comprises delivering a stream of liquid oxygen into the opening or kerf.

3. The process which comprises making a cut in metal at kindling temperature by means of oxygen part of which is delivered into the cut in the liquid state.

4. The process which comprises cutting a kerf in metal at kindling temperature by delivering at and into the metal at least two oxygen streams, one of which is a stream of gaseous oxygen and the other a stream of liquid oxygen.

5. The process of making a deep cut in metal at kindling temperature by means of oxygen which comprises delivering a stream of liquid oxygen into the lower region of the cut.

6. The process of making a cut in metal at kindling temperature with oxygen, in which a stream of liquid oxygen is utilized to project oxygen of high concentration and purity into the cut.

7. The process of cutting a kerf in metal by oxygen characterized in that the oxygen is supplied at least in part by a stream of liquid oxygen delivered into the kerf and displaced relatively to the metal to advance the cut.

8. The process of cutting metal which comprises bringing at least a portion of the metal to kindling temperature, directing a stream of liquid oxygen against the heated metal, and relatively displacing the liquid stream and the metal as the oxygen of the stream cuts through the metal.

9. The process which comprises cutting metal at kindling temperature by delivering at and into the metal a stream of gaseous oxygen and a stream of liquid oxygen, and advancing the streams relatively to the metal with the liquid stream behind the gaseous stream.

10. The process of making a deep cut in metal at kindling temperature, which comprises opening the cut with a stream of gaseous oxygen and completing the cut in the lower regions by the aid of a stream of liquid oxygen acting simultaneously with the gaseous stream.

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