

Jan. 28, 1964

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3,119,409

THERMOCHEMICAL METAL REMOVAL APPARATUS

Filed March 15, 1960

3 Sheets-Sheet 1

Fig. 1.

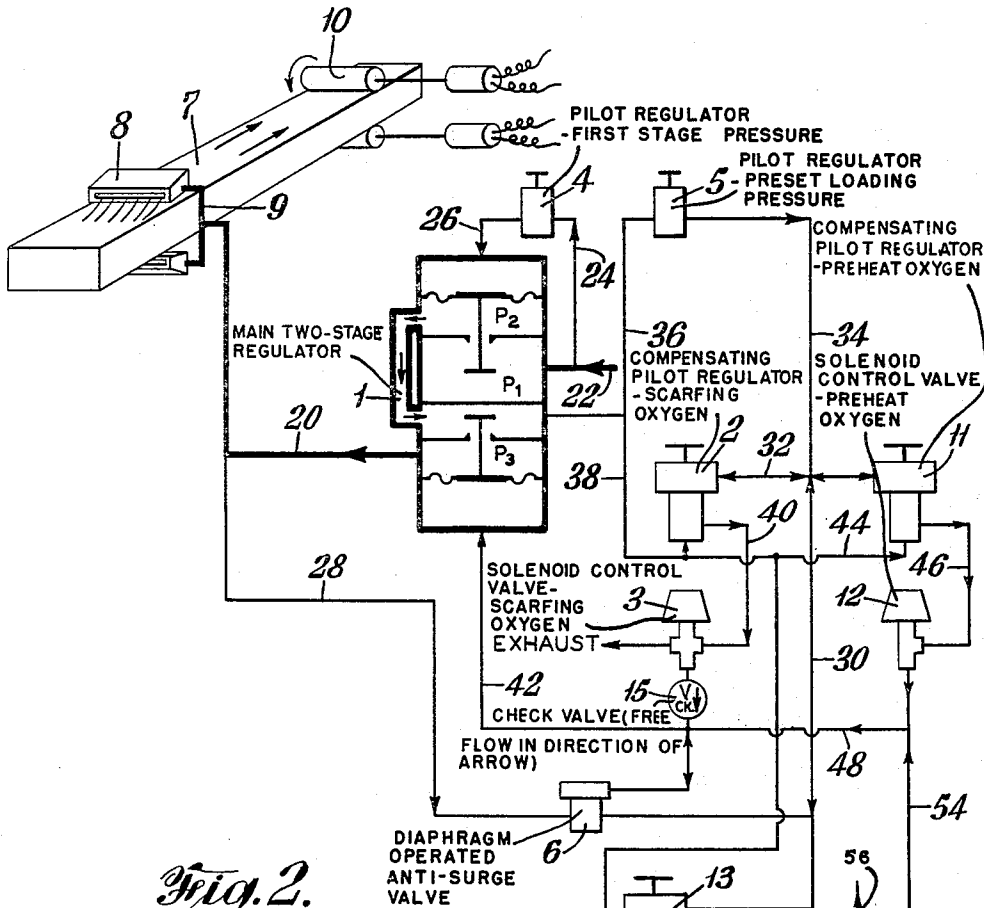
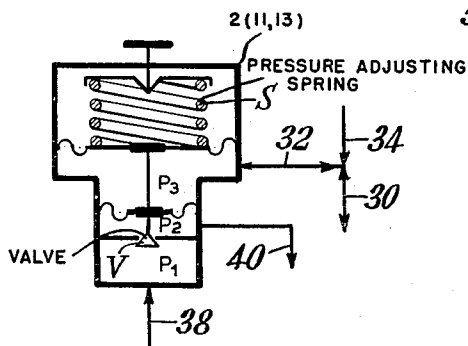


Fig. 2.



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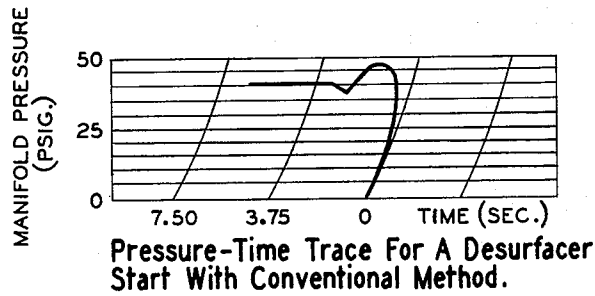


Fig. 3.

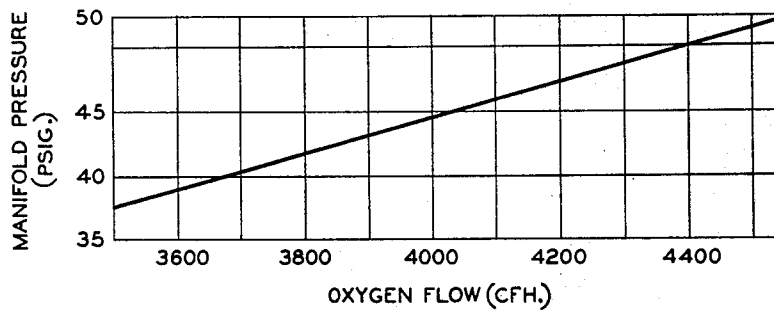


Fig. 4.

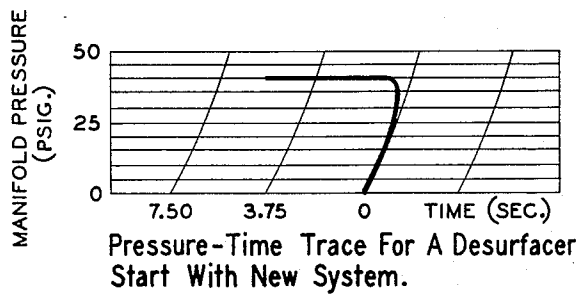


Fig. 5.

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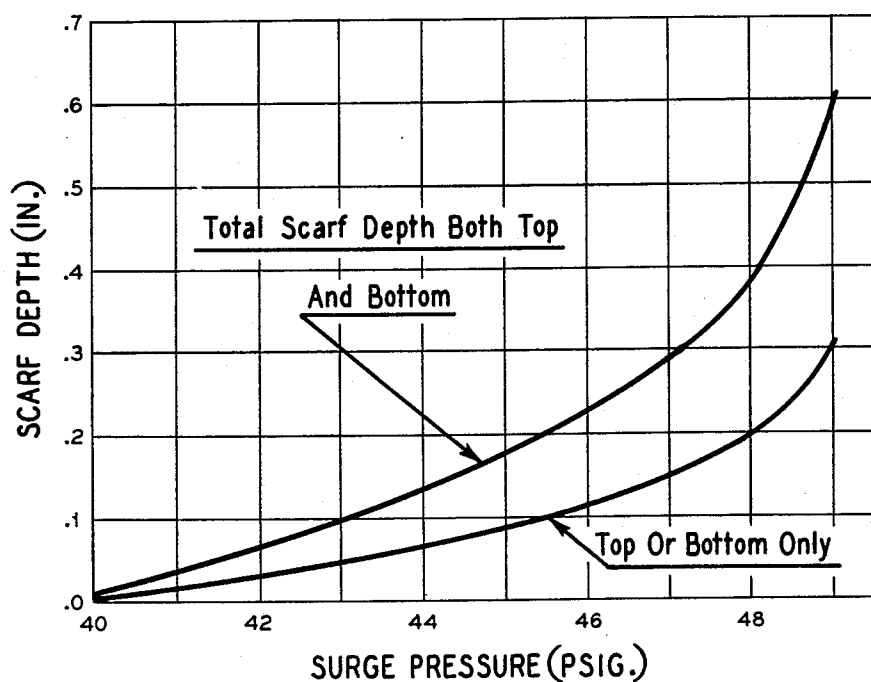
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Relationship Of Scarf Depth To Transient Oxygen Pressure
During Acceleration Of Slab.

Fig. 6.

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THERMOCHEMICAL METAL REMOVAL
APPARATUS

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2 Claims. (Cl. 137-488)

This invention relates to thermochemical metal removal and apparatus, and more particularly to gas circuitry for control of oxygen pressure at the scarfing heads.

It has been found desirable to remove all oxygen regulators and controls from the desurfacing machine and locate them on an oxygen panel about 50 ft. from the machine.

Laboratory tests of the remotely-installed oxygen regulation arrangement were disappointing. The extended distance from the point of oxygen regulation to the point of oxygen use introduced an unacceptable pressure response time. That is, the regulation apparatus received signals too late to compensate for the oxygen volume demand, with the result that deep gouges would occur on starting which would cause serious damage to the slab and to the apparatus.

It is therefore the main object of the present invention to provide a quick response accurate remote control of the oxygen pressure at the scarfing heads. Other objects are to supply scarfing oxygen, preheat oxygen and purging oxygen through the same main station regulator, which serves as a shut off for all oxygen.

In the drawings:

FIGURE 1 is a diagram of the gas circuitry according to the preferred embodiment of the present invention, controlling the oxygen for the scarfing heads of a desurfacing method and apparatus;

FIGURE 2 is an enlarged detail of one of the compensation regulators employed in FIG. 1;

FIGURE 3 is a pressure-time trace showing the problem;

FIGURE 4 is a curve of oxygen pressure against flow;

FIGURE 5 is a pressure-time trace showing the improvement; and

FIGURE 6 is a curve of scarf depth and surge pressure during acceleration.

In order to remove surface defects in steel slabs, the entire top and bottom surface is removed to a depth varying between 0.030 in.-0.0625 inch. In this example, the slab is at 2000 deg. F., is 17 in. wide, and is 6 in. thick. It is to be understood that the two slab edges, or all four sides may be scarfed simultaneously in the same manner.

The conditions considered are at the start of the operation, the pressure at the oxygen manifold=40 p.s.i.g., the oxygen-metal factor=0.625 ft.³O₂/in.³ steel, the preferred scarfing speed is about 130 ft./min., and the constant acceleration of the slab from rest is 1 ft./sec.².

During the testing of the conventional system, various time traces were recorded to obtain manifold pressure data at the start of a scarf involving 15 nozzle segments for the slab top side and 15 nozzle segments for the slab bottomside. One of such time traces is reproduced in FIG. 3. The oxygen flow data per nozzle segment for a pressure variation in the range pertinent to the test is given in FIG. 4.

The significance of the improvement obtained with the system of the invention is evident when FIG. 5 is compared with FIG. 3, the latter indicating the pressure surge above the desired 40 p.s.i.g. level. However, returning to FIG. 3, a study was made of the effect of the surge at and above 40 p.s.i.g. This effect is illustrated in FIG. 4. Note that FIG. 4 represents the dynamic conditions occurring at and above the 40 p.s.i.g. level as related to the oxygen pressure surge.

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During the surge interval, according to FIG. 3, an excessive scarf depth of over .3 in. was obtained on one side, or double that amount for the total for both sides (.6+ in.). Recall as specified the scarf depth should be within the limits of 0.030 in.-0.0625 in. per side. Obviously, 5 to 10 times as much metal is removed at the start of scarfing than is both desirable and acceptable. The great excess of metal loss is wasteful and very damaging to the apparatus by plugging up of the oxygen and preheat orifices from the splatter.

As shown in FIG. 1, the slab 7 passes between scarfing heads 8 supplied with oxygen by a manifold 9, the slab being propelled by motorized feed rolls 10. Oxygen is fed to the manifold 9 by a feed line 20 leading from a main supply line station regulator 1, which is a two stage regulator.

The pressure from the main oxygen supply line 22 is applied through line 24 to a pilot regulator 4, from which the regulated constant pressure is applied through line 26 against the first stage diaphragm of regulator 1. In the first stage, the pressure from the main supply line 22 is reduced to an intermediate pressure of preferably 85 to 90 p.s.i. In the second stage, this intermediate pressure is further reduced to the desired working pressure preferably about 40 p.s.i. delivered to the feed line 20 for the manifold.

The manifold pressure is transmitted through the line 28, the open diaphragm operated anti surge valve 6, and lines 30 and 32 to the compensating regulator 2. Variations in manifold pressure are thereby transmitted to P₃. This compensating regulator 2 and regulators 11 and 13 hereinafter referred to, are of the type disclosed in FIG. 2.

Also acting on this compensator regulator 2 through lines 32 and 34 is the preset loading pressure of pilot regulator 5, which regulates pressure received from the first stage of main regulator 1 through line 36. This pressure from the pilot regulator 5 controls the timing and extent of the variations in manifold pressure received from line 28. The pressure from the first stage of the main regulator 1 is also applied against pressure zone P₁ of compensating regulator 2 through line 38.

The scarfing operation is controlled by a remote controlled solenoid operated control valve 3, which opens the line 40 from the compensating regulator 2. Pressure therefrom is applied through line 42 to the second stage diaphragm of main regulator 1, and opens the delivery valve thereof so that oxygen flows through line 20 and manifold 9 to the scarfing heads 8.

During the same interval, the pressure P₃ in the compensating regulator 2 momentarily drops, see FIG. 2, whereupon the force of the diaphragm spring S in the compensator pilot regulator 2 opens the valve V, which increases the pressure P₂. Thus through line 40, valve 3 and line 42 to the second stage pressure of main regulator 1 increases the flow to the manifold 9. To limit the pressure increase at P₂, pilot regulator 5 through lines 32 and 34 maintains a constant pressure on compensating regulator 2.

In the preheat system, pressure from the first stage of main regulator 1 is applied to the compensating type preheat regulator 11 through lines 38 and 44, which pressure is reduced in regulator 11 and transmitted by line 46 to remotely controlled solenoid operated valve 12, which controls the preheat oxygen flow by controlling the pressure transmitted to the second stage of main regulator 1 through lines 48 and 42. The check valve 15 prevents flow of oxygen from preheat pilot regulator 11 through valve 3 which is open during the preheat cycle.

In the purging system, pressure from the first stage of main regulator 1 is applied to the purging oxygen regulator 13 through lines 38 and 50, which pressure is re-

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duced in regulator 13 and transmitted by line 52 to the diaphragm operated shut off valve 14, which controls the purging oxygen flow by controlling the pressure transmitted to the second stage of main regulator 1 through lines 54, 48 and 42.

The line 56 from the valve 14 leads to and from a three-way solenoid valve for lateral side desurfacing, not illustrated but equivalent to valve 3 illustrated for the top and bottom system of FIG. 1.

What is claimed is:

1. Apparatus for remotely controlling the flow of oxygen to a manifold feeding a plurality of scarfing units, in order to maintain a substantially constant pressure at said manifold as fluctuations in oxygen flow occur at said scarfing units, which comprises means for passing the oxygen from a main line through a remote two-stage regulator for a long distance to said manifold, means for transmitting a feedback pressure from a point of use adjacent said manifold for a long distance to a remote compensator regulator which varies the delivery pressure therefrom inversely in response to fluctuations in said feedback pressure and which has conventional manual adjusting means, means for applying a constant loading pressure to said compensator regulator by a pilot regulator in order to prevent hunting by said compensator and to modify the feedback pressure, said modified feedback pressure acting against said conventional manual adjusting means to control the output of said compensating regulator, and means for transmitting the delivery pressure from said compensator regulator to the second stage of said main regulator to increase or decrease the flow of oxygen therefrom to said manifold feeding said scarfing units.

2. Apparatus for remotely controlling the flow of oxygen from a main line to a manifold for scarfing heads,

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which comprises means for passing the oxygen from said main line through a main two-stage regulator to said manifold, means for transmitting feedback pressure drop from a point of use adjacent said manifold through a separate line to a compensator regulator which varies the delivery pressure thereof inversely as the pressure at the point of use and which has conventional adjusting means, means for applying a constant loading pressure to said compensator regulator by a pilot regulator to modify the feedback pressure drop, said modified feedback pressure drop acting against said conventional manual adjusting means to control the output of said compensating regulator, and means for transmitting the delivery pressure from said compensating regulator through another line to the second stage of said main regulator to increase the flow of oxygen therefrom through said feed line to said manifold for said scarfing heads.

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