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EUROPEAN PATENT APPLICATION

21 Application number: 79302060.3

51 Int. Cl.³: **C 22 C 38/00**
C 21 D 9/00, A 01 B 15/08

22 Date of filing: 01.10.79

30 Priority: 02.10.78 GB 3895578
04.04.79 GB 7911745

43 Date of publication of application:
28.05.80 Bulletin 80 11

84 Designated Contracting States:
BE DE FR IT LU NL

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54 **Agricultural mould-boards and method for manufacturing same.**

57 The invention is an agricultural mouldboard formed from a steel containing sulphur or sulphides into which there has been incorporated sufficient of a rare earth element or elements or at least one other sulphide shape modifying element to form sulphides or substantially globular form. A particularly useful steel has a composition, by weight, substantially as follows:

0.6 to 1.2% carbon;
up to 0.35% silicon;
up to 0.02% sulphur;
up to 0.05% phosphorus;
0.5 to 1.5% manganese;
up to 1.0% chromium;
up to 0.10% rare earth element or other sulphide shape modifying element.

The mouldboard is made by gradually and uniformly heating a blank of the modified steel in a furnace to a temperature whereat it can be formed, forming said blank into the desired mouldboard shape, and quenching the thus formed article.

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"AGRICULTURAL MOULDBOARDS".

This invention relates to mouldboards for tractor plough bodies.

For many years such mouldboards have been manufactured from three-ply iron and steel, i.e. two sheets of steel with an iron sheet sandwiched between. The reason for using this three-ply iron and steel, which is produced by hot sheet rolling, is to resist wear and breakage.

The mouldboard is part of a plough body, and works by lifting the furrow slice, the mouldboard contour turning the slice sideways and laying it against a similarly turned slice of a previously made furrow.

The mouldboard has the abrasion of the soil against it, both back and front, although more so with the front. This action of the mouldboard passing through the soil causes it to wear. In addition to this it can encounter a variety of objects creating a danger of breakage or fracture.

It is, therefore, necessary that mouldboards be made from a material that will resist wear and breakage.

Common manufacturing practice is to use three-ply iron and steel, and harden the steel outer surface followed by fine finishing of the working face. This produces the advantage of the outer surfaces being wear resistant and the support given by the soft iron core being resistant to breakage or fracture.

It should, however, be noted that when working, random chipping around the edges of the mouldboard is quite possible, but this ordinarily does not impair the mouldboard's function.

What is desirable in a mouldboard is the avoidance of a "straight-line" fracture, which in the case of an all steel mouldboard would result from directional grain flow of the steel from which the component is made. Any such "straight-line" fracture would render the mouldboard useless, and the machine would have to be stopped and the mouldboard replaced.



The object of this invention is to provide an all-steel mouldboard which is not liable to such breakage as would render the mouldboard useless, and which has reasonable wear resistance, so that a set of assembled mouldboards on a plough will give a consistent performance and avoid the problem of replacing individual mouldboards whilst the plough is in operation.

According to the present invention a mouldboard is formed from a steel containing sulphur or sulphides into which there has been incorporated sufficient rare earth elements or other sulphide shape modifying elements to form sulphides of substantially globular form.

Further according to the invention, a method for the manufacture of a mouldboard comprises gradually and uniformly heating a blank of steel incorporating sulphide shape modifying elements in a furnace to a temperature whereat it can be formed, forming said blank into the desired shape, and quenching the formed article.

This Specification now refers to the steelmaking practice and the subsequent processing of this steel, particularly referring to the controlled shaping and hardening technique to ensure a consistently high standard of mouldboard.

This subsequent processing is designed to make the best use of this high grade of steel in the hot rolled form, to ensure a consistently high standard of mouldboards.

The directionality of any steel structure is primarily influenced by non-metallic inclusions such as sulphides and silicates. If the form of these can be controlled so that the formation of stringers can be prevented and instead the sulphur content presented in spheroidal or globular form, and randomly distributed, then the directionality of the steel will be minimised or even eliminated. This desired standard is achieved in the steel used in the present invention by adding rare earth elements, such as cerium and lanthanum, or other sulphide shape modifying elements as calcium, titanium or zirconium in amounts

appropriate to the sulphur content of the steel, and related to the rest of the steelmaking practice.

One convenient form of rare earths is the compound called Mischmetal, containing approximately 50% cerium, 25% lanthanum, the remainder being other rare earth elements. Another suitable way of introducing cerium into the steel composition is in the form of ferro-cerium.

Because of the strong affinity of rare earth elements for sulphur, oxygen and silicon, the whole deoxidation desulphurisation and grain refining practice has to be carefully controlled. The practice of rare earth additions should preferably be used on steel of very low sulphur content, less than 0.05%, suitably less than 0.02%. By using a double slag process to ensure both low sulphur content and clean steel, the rare earth additions are kept to low amounts yet still ensuring the complete modification of the form of the non-metallic inclusions.

Also the steel should be thoroughly deoxidised, using aluminium or other grain refining elements, in such amounts that complete grain refining is achieved.

This method of preventing marked directionality in the rolled strip, sheet or plate, by modifying the form of the sulphides, is quite distinct from the post-steelmaking procedures that are already utilised to try to obviate such directionality, namely the use of cross-rolling in varying degrees, whether from slab to form sheet or the transverse rolling of thick strip, or the use of the austempering process of heat treatment which is claimed to minimise or eliminate directionality.

The steelmaking practice necessary to be associated with the additions of rare earths or other sulphide modifying elements incorporates the following details:-

- Double slag practice to give 0.02% max. sulphur.
- Inherent fine grain steel to McQuaid-EHn 5-8 (or equivalent measurement such as ASTM 5 and finer).
- Silicon, content preferably 0.35% max.
- Completion of deoxidation, and the inherent fine grain

refining elements to a slight excess.

Highest possible standard of cleanness consistent with the above requirements.

When rolled to sheet, the grade of slab can be chosen
5 so that apart from the desired absence of deleterious defects of any kind, including segregation and pipe, the surface finish is of a high standard that will allow further processing to yield mouldboards free from unacceptable flaws.

Likewise, when rolled to produce hot rolled strip, the
10 surface of the strip is preferably free from unacceptable surface flaws.

Likewise, when rolled to produce hot rolled strip, the surface of the strip is preferably free from unacceptable surface flaws. To this end, it may sometimes
15 be necessary to specify a pickled surface.

A high carbon steel composition for use according to the invention may contain, by weight, 0.6% to 1.2% carbon, up to 0.35% silicon, up to 0.02% sulphur, up to 0.05% phosphorus, 0.5 to 1.5% manganese, up to 1.0% chromium,
20 and up to 0.10% rare earth metal, or equivalent amount of other sulphide shape control elements the remainder being predominantly iron and unavoidable residual elements, the sulphur being present in the form of sulphide of substantially globular form. A particularly useful high carbon
25 steel specification for making agricultural mouldboards in accordance with the invention is:-

C - 0.85%: Si - 0.15% max: S - 0.015% max: P - 0.030% max:
Mn - 1.0%: Rare earth addition 1½-2lb/tonne (theoretical yield is 0.067 to 0.089%) as Mischmetal as outlined above
30 and grain refined.

In the manufacture of mouldboards, strip sheet or plate is manufactured from a suitable steel as previously described and is cold blanked or pared to its flat shape, and any mounting holes are punched or drilled and reamed as necessary.

35 The blanks are then loaded into a furnace, for example the "walking beam" furnace shown schematically in Figures

1 and 2 of the accompanying drawings.

The furnace of Figures 1 and 2 is designed to accomplish uniform heating of the blanks and regulate a consistent delivery to the press form/quenching units.

5 Referring to Figure 1, the arrow indicates the progression of the blanks through the furnace which is commonly called a "walking beam" furnace.

A burner (a) e.g. a gas or oil burner, is mounted at the loading end, and is designed to produce the maximum
10 temperature of the work at the discharge end (b).

The temperature of the blank at discharge is governed by:-

- (i) rate of throughput and
- (ii) heat generated by the burner.

15 In no case should the blank be subjected to a temperature that will give grain coarsening.

As stated hereinbefore the advantage of the specially designed "walking beam" furnace to heat mouldboard blanks is in accomplishing a gradual rise in temperature, and
20 thus minimising an overshoot.

The slot (c) in the hearth (Figure 2 - which is an end view of the furnace) allows through-heating of the blank, the result being a consistently heated blank at the discharge point (b) of the furnace.

25 Another advantage of the furnace is the saving in heat and time in bringing the furnace up to a working temperature.

The top of the furnace (d) is built on a modular construction and any worn or burnt out section can be
30 quickly replaced. A ceramic fibre lining for roof and walls is used to reduce heat losses.

The blanks are suitably picked up by vacuum pads and are deposited at the entry (e) to the furnace and thence on to the "walking beam" (f). This loading
35 device is interlocked with the furnace circuitry, and carefully timed to the furnace temperature and bending press operation or press-form quenching unit.

The beam (f) is actuated by an air cylinder, and the beam assembly (g) traverses along tracks mounted at the base of the furnace through rollers (h).

5 The heated mouldboard blanks are removed from the furnace exit (b) at an appropriate hardening temperature and fed into the press form/quench tools shown in side and plan view respectively in Figures 3 and 4 of the accompanying drawings.

10 These tools are designed to hot form the blanks into the required mouldboard shape and comprise a stationary tool (a) and a moving mating tool (b). Both are formed with a plurality of holes (c) through which quenching fluid may flow.

15 The flat mouldboard blank is set into the stationary tool (a) to a stop position, and the moving tool (b) is actuated downwardly, thus forming the ultimate shape of the mouldboard.

20 At this time the pressure is slackened off slightly and oil is pressure-fed to both tools, the oil flowing through the holes (c) completely to submerge the newly shaped blank.

The timing of the quench is governed to harden the blank and the oil feed can be varied to either face for sudden or delayed quenching.

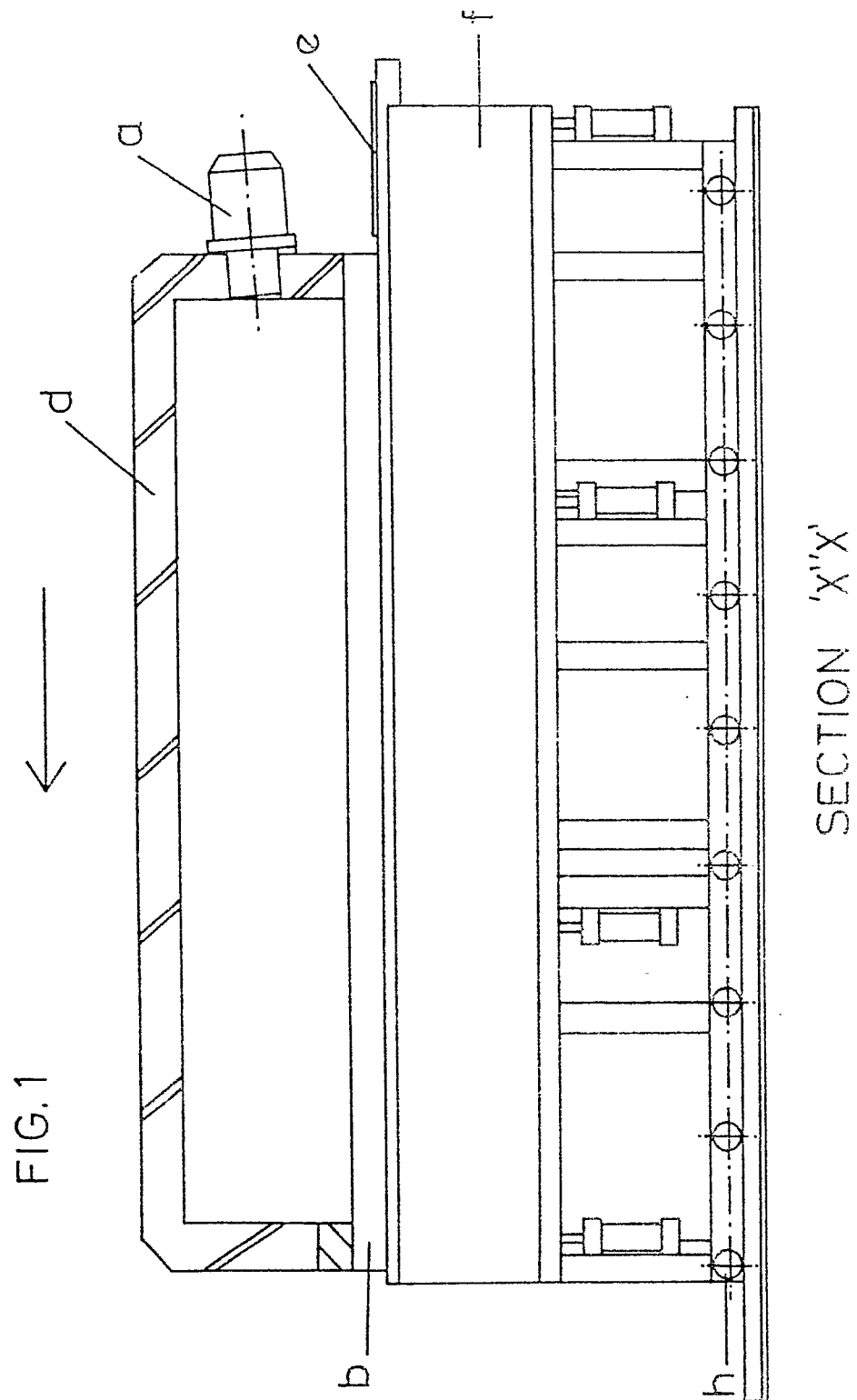
25 The purpose of this action of press form/quenching is to make the shape and hold to the required contour during the quenching process, avoiding the change of shape that otherwise prevails in free quenching.

30 When the required hardening has been achieved the component is then ready for tempering and final surface operations can be undertaken. In a typical operation the formed mouldboard may be quenched to a hardness in excess of 810 Hv30, lightly tempering back to an acceptable working hardness, for example, 750-800 Hv30.

What is claimed is:-

1. A mouldboard formed from a steel containing sulphur or sulphides into which there has been incorporated sufficient of a rare earth element or elements or at least one other sulphide shape modifying element to form sulphides of substantially globular form.
2. A mouldboard according to claim 1 wherein the steel contains at least one rare earth element.
3. A mouldboard according to claim 1 wherein the steel has a composition, by weight, substantially as follows:-
0.6 to 1.2% carbon;
up to 0.35% silicon;
up to 0.02% sulphur;
up to 0.05% phosphorus;
0.5 to 1.5% manganese;
up to 1.0% chromium;
up to 0.10% rare earth element or other sulphide shape modifying element.
4. A mouldboard according to claim 3 wherein the steel has the approximate composition, by weight:-
0.85% carbon;
0.15% max. silicon;
0.015% max. sulphur;
0.030% max. phosphorus;
1.0% manganese;
0.067 to 0.089% Mischmetal.
5. A method for the manufacture of a mouldboard, comprising gradually and uniformly heating a blank of steel incorporating at least one sulphide shape modifying element in a furnace to a temperature whereat it can be formed, forming said blank into the desired mouldboard shape, and quenching the thus formed article.
6. A method according to claim 5 wherein the sulphide shape modifying element is at least one rare earth element.
7. A method according to claim 5 wherein the steel has the composition set out in claim 3 or claim 4.

8. A method according to claim 5 wherein the forming of the blank and the quenching of the formed blank occur in the same press tool.



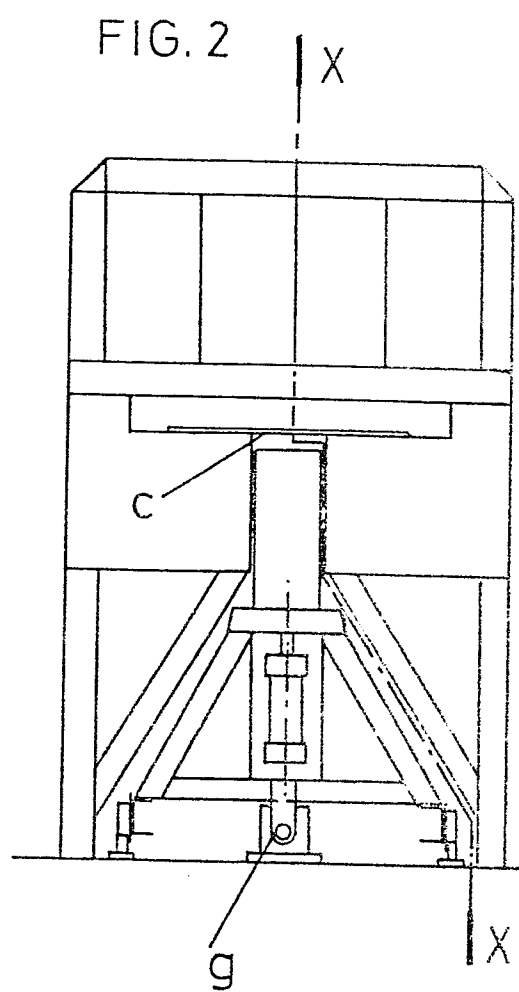


FIG. 3

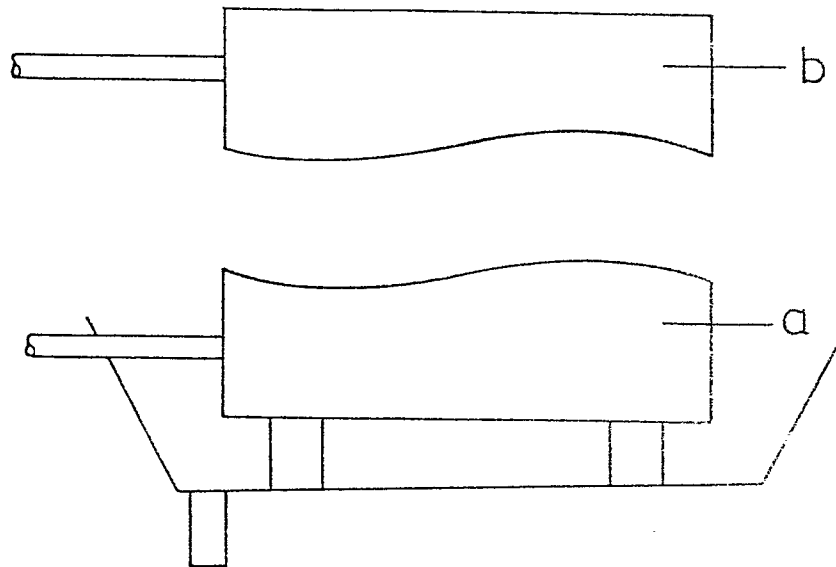
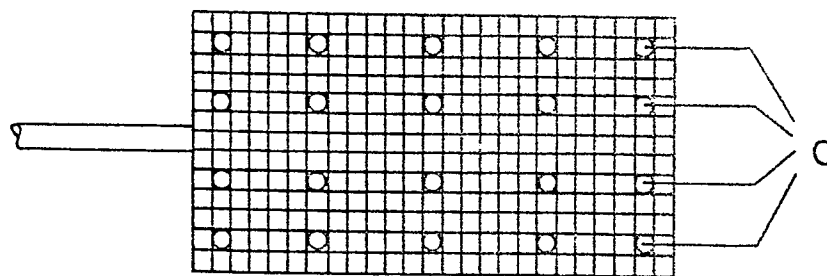


FIG. 4



0011365
Application number



European Patent
Office

EUROPEAN SEARCH REPORT

EP 79 302 063.1

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>US - A - 4 098 622</u> (INTERNATIONAL HARVESTER) * column 10 * ---	1,5	C 22 C 38/00 C 21 D 9/00 A 01 B 15/08
	<u>DE - A - 2 003 306</u> (TOYOTA) * page 26 * ---	5	
	<u>DE - A1 - 2 603 618</u> (KENEBC) * page 14 * ---	5	TECHNICAL FIELDS SEARCHED (Int. Cl.)
	<u>DE - A1 - 2 706 597</u> (HONDA) * page 3 * ---	5	A 01 B 15/08 C 21 D 9/00 C 22 C 38/00
	<u>US - A - 3 806 379</u> (CRUCIBLE) -----		CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search	Date of completion of the search	Examiner	
Berlin	30-01-1980	ALTON	

