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FACILITY FORM 602

REPLY TO ATTN OF: GP

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,487,680

Government or Corporate Employee : GOVERNMENT

Supplementary Corporate Source (if applicable) : NA

NASA Patent Case No. : XLA-05100

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐ No ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words "... with respect to an invention of . . ."

Elizabeth A. Carter

Enclosure

Copy of Patent cited above

N71-17696

Jan. 6, 1970 F. F. EICHENBRENNER ET AL 3,487,680

HYDRAULIC GRIP

Filed April 26, 1968 2 Sheets-Sheet 1

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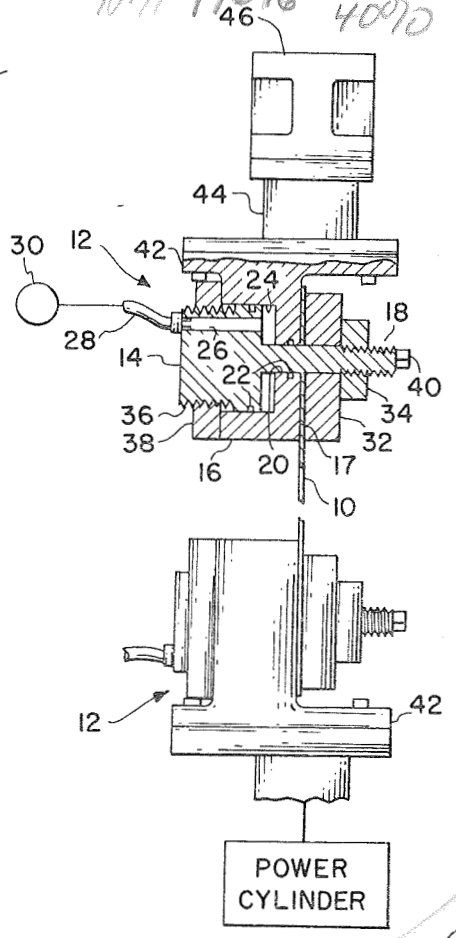
FIG. 1



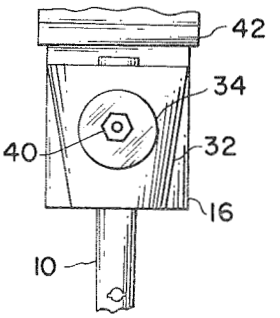


FIG. 2

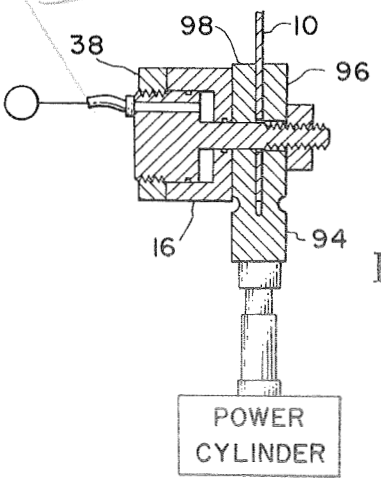


FIG. 5

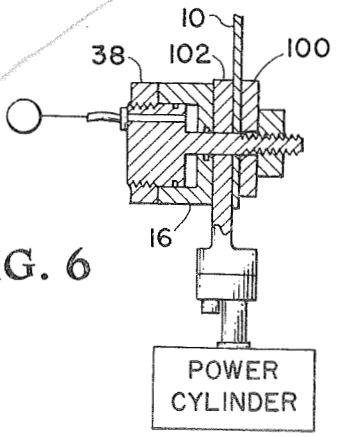


FIG. 6

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HYDRAULIC GRIP

Filed April 26, 1968 2 Sheets-Sheet 2

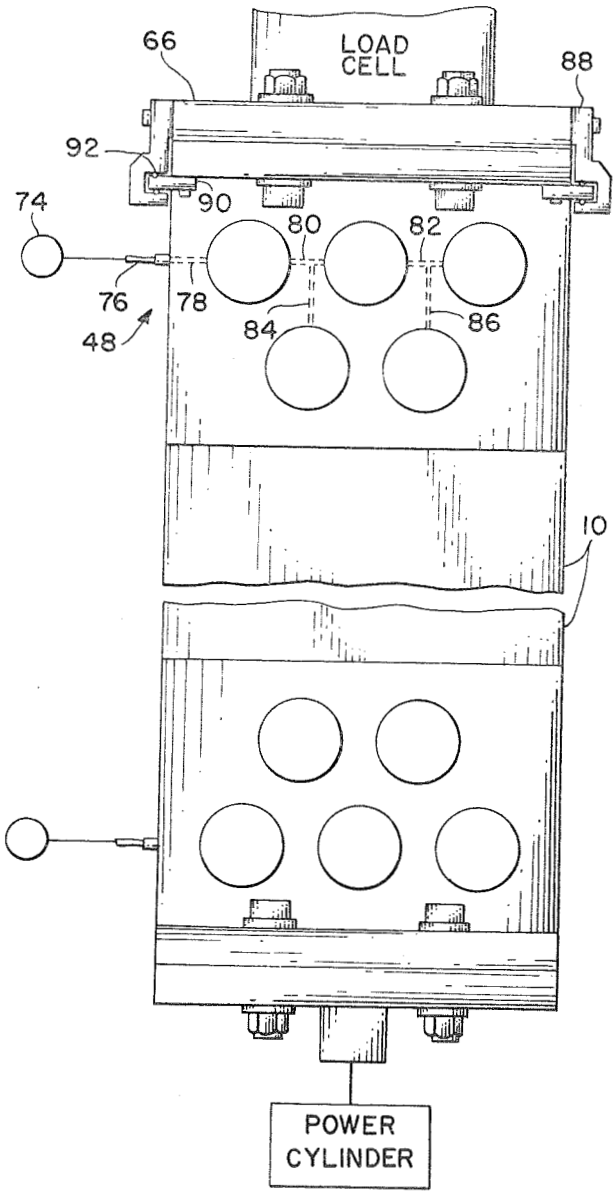

FIG. 4

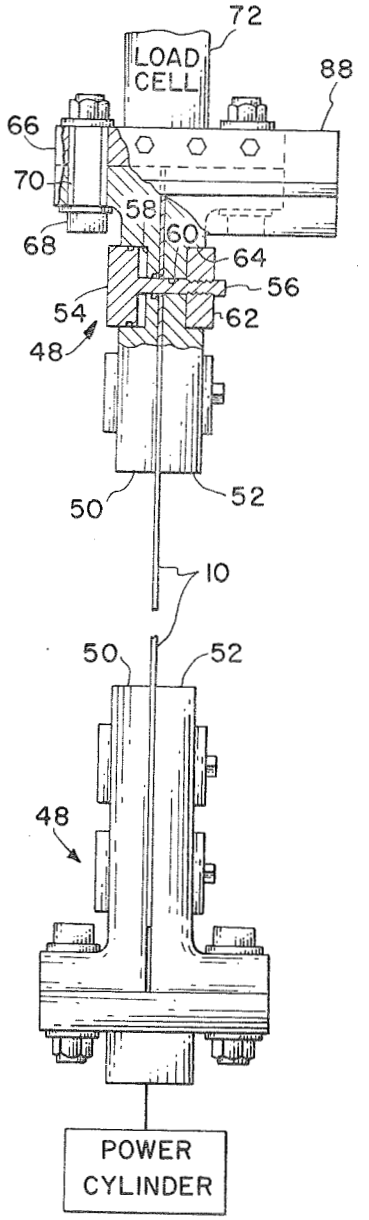

FIG. 3

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United States Patent Office

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Patented Jan. 6, 1970

3,487,680

HYDRAULIC GRIP

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Filed Apr. 26, 1968, Ser. No. 724,551
Int. Cl. G01n 3/36
U.S. Cl. 73—103 14 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for clamping sheet stock specimens in a test machine, featuring the use of hydraulic clamps to secure the specimen. The several types of clamps disclosed generally consist of a piston in a cylinder, with a rod extending through the pressure chamber, the end wall, the specimen, and clamping plate or plates, which are retained by a fastener so that pressurization of the chamber produces a clamping action.

This invention relates to clamping arrangements for clamping sheet stock specimens into mechanical testing machines and also to specific hydraulic clamps especially suited for this purpose.

Prior art devices for fastening the ends of sheet metal specimens into the grips of a testing machine have usually consisted of a pair of jaws having a plurality of screws passing through them and arranged to draw the jaws together and grip the specimens as they are tightened down. These prior art devices, while not wholly unsatisfactory, suffered from several disadvantages, among these being the rotary strain induced in the specimen as the screws are tightened, which in turn leads to upsetting of the stress patterns desired in axial loading fatigue tests. A second disadvantage was the nonrepeatability of the gripping pressure since galling on the screw ends, deterioration of the threads, and variation in lubrication would vary the effect of given torques applied to the individual screws. In addition, these devices were rather slow and laborious to use.

Therefore, it is an object of the present invention to provide a means of clamping sheet metal specimens into mechanical test machines without inducing rotary strains in the specimen.

It is a further object to provide a device capable of clamping sheet specimens with a highly repeatable clamping pressure.

It is yet another object to provide a device which will rapidly and easily clamp or release such a specimen into a test machine.

Another object of the present invention is to provide novel hydraulic clamps which are particularly suited to the purpose of clamping such specimens into mechanical testing machines.

These and other objects which will become more apparent upon an inspection and reading of the drawings and specification are accomplished by the use of hydraulic clamping arrangements wherein a uniform clamping pressure is applied with a minimum distortion of parts to the specimen to be fastened.

In the drawings, FIG. 1 is a side elevation in partial section of a test machine with a sheet specimen clamped therein.

FIG. 2 is a partial front elevation of the same assembly;

FIG. 3 is a partial view of a side elevation in partial section of a test machine with a specimen clamped therein with another form of hydraulic clamp;

FIG. 4 is a front elevation of the same assembly;

FIG. 5 is a partial view of a side elevation of another form of hydraulic clamp used in a test machine;

FIG. 6 is a partial view of a side elevation of another form of hydraulic clamp used in a test machine.

Referring now to the drawings, FIG. 1 shows the basic layout of the test setup for mechanical test of a sheet metal specimen. The specimen **10** is clamped at both its upper and lower ends with a hydraulic clamp assembly **12**, including a piston **14** disposed in a cylinder block **16**. The piston **14** has an elongated rod **18** secured thereto and passing through the cylinder end wall through the bore **20**. Fluid seals **22** are provided in order to provide a fluid-tight hydraulic chamber **24**. Passageway **26** through the piston is provided and is in communication with fluid line **28** and a source of fluid pressure **30**, so that the chamber **24** may be pressurized with a fluid pressure. Cylinder block **16** is formed with a flat end wall **17**, which acts as a reaction surface for the clamping action as to be more fully described herein.

Clamping plate **32** is slidably disposed on a portion of the rod **18**, and is retained thereon by the nut **34** which threadedly engages the end of the rod **18**. The nut **34** provides a degree of adjustment to the travel of the clamping plate **32** to allow for specimens of varying thicknesses. The rod end may be formed with a hex head **40** thereon in order to loosen either the nut **34** or the locking ring **38** in case some binding in the threads is encountered.

The end of the piston **14** is threaded at **36** in order to receive a locking ring **38** threaded on its interior to engage the piston **14**.

The upper portion of the cylinder is formed with a flat plate **42** which is bolted to a load measuring device such as a weigh-bar **44**, which is in turn secured to the test machine frame **46**. The lower hydraulic assembly **12** has the plate member **42** secured to the power cylinder assembly for inducing loads on the specimen **10**. In use, the specimen to be tested is slipped over the projecting upper and lower rods **18**, from which the clamping plates and force nuts have been removed. These elements are then replaced and fluid pressure is introduced to line **28** pressurizing the chamber **24** and causing the pistons **14** to move away. This produces a clamping action between the cylinder end walls **17** and the clamping plates **32** with a force magnitude directly related to the piston area and the pressure level maintained in the chamber **24**. It should be noted that the cylinder end wall **17** acting as reaction surface is held against movement by the clamping plate **32** by the force of the fluid pressure in the chamber **24** directed in the opposite direction.

After the desired clamping force is attained, locking rings **38** are hand-rotated until they engage the cylinder **16**. The fluid pressure is then relieved to produce a solid mechanical lock at both ends of the specimen, to allow the desired loadings to be induced.

It should be pointed out that this lock has been accomplished without inducing rotary strain on the specimen since the hydraulic clamp **12** operates with a straight pull, and the locking ring **38** is only rotated by hand and no significant torque is applied thereto. Secondly, this clamping pressure is highly repeatable since it varies only with the pressure applied to chamber **24**, and this parameter is rather easily and precisely monitored and controlled. Thirdly, the clamping pressure applied to the specimen is evenly distributed due to the low distortion

design of the clamp. This is a result in part to the arrangement whereby clamping forces are transmitted by a rod under tension rather than a compression, resulting in elimination of the usual substantial buckling deflections encountered in a piston and cylinder combination, and in part to the countering of the reaction forces in the system to produce a zero net force on the hydraulic assembly. Thus forces acting on cylinder **16** to the left due to the clamping action of plate **32** are just balanced by the force to the right induced either by the fluid pressure on the end wall or the force ring **38**. Hence, distortion and misalinement of the parts is minimized, resulting in an even pressure distribution across the face of the clamping surfaces and elimination of racking loads induced by such an uneven pressure distribution. In addition, lateral loads on the weigh-bar **44** are similarly eliminated.

It is also seen that the process of installing a specimen is rendered much more rapid and is more easily accomplished than that utilizing the manually operated clamps.

A variation of this assembly is shown in FIGS. 3 and 4. The general arrangement is the same, in which a specimen **10** is fastened at its ends by hydraulic clamp assemblies **48**. However, each hydraulic clamp is provided with a plurality of piston and rod subassemblies slidably received in right and left cylinder block plates **50** and **52**. Each subassembly consists of a piston **54** and a rod **56** secured thereto, the piston received in a bore in the plate **50** to form a chamber **58**. The rod **56** passes through both plates through openings **60**, and threadedly engages a force nut **62**, which may be received in a counterbore **64** formed in plate **52**.

Plates **52** and **50** are both secured to a plate **66** by means of cap screw and nut assemblies **68** passing through elongated holes **70**, while this plate is in turn secured to a load cell **72** which is secured to the test machine frame.

Fluid pressure is supplied to each cell by means of a pressure source **74**, line **76**, and interconnecting passages **78**, **80**, **82**, **84** and **86** which communicate with each chamber **58**.

Each of the plates **50** and **52** are mounted so as to be slidable in track assemblies **88**, fastened to the upper plates **66**. A pair of bars **90** fastened to each of the plates **52** and **50** fitting into the track assemblies may be engaged with bearing assemblies **92** so that each of the plates may be freely slid back from the position shown in FIG. 3 when cap screw and nut assemblies **68** are not in place.

In use, the plates **50** and **52** are withdrawn to a point where the rod **56** does not pass into plate **52**, cap screw and nut assemblies and force nuts **62** having been removed. The specimen **10** having been predrilled for this purpose is then slipped over the rods **56** and plates **50** and **52** are advanced into engagement. Cap screws and nut assemblies **68** and the force nuts **62** are then installed to finger tightness. The introduction of fluid pressure into each clamp assembly **48** causes a pressurizing of all of the chambers **58** to produce a desired clamping force on the specimen **10**.

This apparatus while incorporating the advantages and functioning of the single cell hydraulic clamp, possesses the additional advantage of producing a uniform clamping pressure simultaneously over a relatively great area, since an equal fluid pressure must exist everywhere in a system such as disclosed. Therefore, while the clamping force of a plurality of screws is not uniform in magnitude nor can they be applied simultaneously, this apparatus possesses both of these capabilities, hence reducing warping strain in specimens of relatively large widths.

Furthermore, due to the track support, and relatively rapid and effortless application of the clamping force, this result is accomplished more easily and with greater speed than with prior art device.

Another variation of the apparatus is shown in FIG. 5. This apparatus is similar to that shown in FIGS. 1 and 2 except that instead of a single clamping plate **32**, a forked member **94** is used, and the clamping action occurs between the tine members **96** and **98** instead of between the clamping plate **32** and the cylinder. Thus, the fork **94** may be secured to the power cylinder or load cell rather than the cylinder while keeping the specimen centered along the line of action of the power cylinder, resulting in a somewhat smaller and simpler structure, while retaining the advantages of the basic hydraulic clamping arrangement. The tine **98** acts as the reaction member and is maintained against movement by the action of tine **96** by the effect of the nullifying force applied by the cylinder block **16** produced either by the internal fluid force or the locking ring **38**.

A final variation is shown in FIG. 6. Here, a separate reaction plate **102** is secured to the power cylinder, and the clamping plate **100** is not connected thereto, as in the forked arrangement of FIG. 5, allowing freer clamping movement of the plate **100**.

Therefore, it can be seen that an arrangement has been provided for clamping specimens into a test machine with a minimum of distortion of the specimens induced by the clamping process, with a highly controllable and repeatable clamping pressure, and which is applicable to specimens of considerable proportions. The process is also fast and relatively effortless.

In addition, it can be seen that a novel hydraulic clamp has been provided in which distortion of the components is minimized, allowing great clamping pressures to be exerted without significant deflection of the parts which would lead to uneven pressure distribution across the clamping surfaces.

It should be understood the invention is not to be limited to the particular embodiments disclosed, as these are intended to be illustrative of the invention. It also should be noted that some of the invention's advantages may be gained by the use of a single hydraulic clamp in a testing machine. The specimen may be first clamped at one end with a prior art device, and since the other end is free, rotary strains are largely avoided. Then the opposite end may be clamped with a hydraulic clamp according to the present invention, thus eliminating the inducement of rotary strain in the specimen.

Therefore, the invention is to be limited only by the following claims:

1. A hydraulic grip comprising:
block means having a passage formed therein;
a piston movably fitted into said passage and having a portion which protrudes out of said passage in a portion of its range of movement;
means for selectively producing a net fluid force on said piston and disposed opposite said one direction;
connector means drivingly connecting said piston and said clamping element;
a reaction element interposed between said clamping element and said piston; and
means securing said reaction element against movement by said clamping element in response to said fluid force;
an enlarged element fitted over said piston; and
means for positioning said element against movement along said piston at selective points along said protruding portion of said piston.

2. The grip of claim **1** wherein said connector means includes a rod extending through said passage, and also includes engagement means drivingly connecting said rod to said clamping element.

3. The grip of claim **1** wherein said positioning means comprises a threaded connection between said piston and said enlarged element.

4. The grip of claim **2** wherein said engagement means includes a threaded portion on said rod extending through said clamping element and a force nut threadedly engaging said portion.

5. The grip of claim 1 wherein said reaction element comprises an end wall formed in said block means.

6. A hydraulic grip comprising:

block means having a plurality of spaced parallel passages formed therein;

a plurality of pistons each slidably fitted into a respective passage;

means for creating fluid chambers between one of the respective piston ends of each piston and said block means;

means providing fluid communication between said fluid chambers;

means for providing a fluid pressure to said chambers;

a clamping element spaced from said pistons;

means drivingly connecting each of said pistons and said clamping element;

a reaction element in juxtaposition with said clamping element; and

means for securing said reaction element against move ment by said clamping element, whereby a uniform clamping force is created by each piston and passage assembly by the introduction of fluid pressure to said chambers.

7. The grip of claim 6 wherein said clamping element is located with said chambers between said pistons and said clamping element, and said reaction element is interposed between said pistons and said clamping element.

8. The grip of claim 7 wherein said connecting means each includes a plurality of rods each connected to a respective piston and passing through its respective fluid chamber.

9. The grip of claim 8, wherein each of said connecting means further includes a portion of the rod extending through a passage in said clamping element, a nut member threadedly engaging said portion of the rod and of a larger size than said passage.

10. Apparatus for testing a sheet specimen comprising:

a pair of spaced elements;

power means selectively producing relative movement between said pair of spaced elements;

means for clamping portions of said specimen to said spaced elements, including at least one hydraulic clamp comprising a pair of members, at least one of which is connected to one of said spaced elements, and a hydraulic chamber having a slidable element disposed therein drivingly connected to a first one of said members with said chamber interposed therebetween and movable in response to fluid pressure therein and the second of said members interposed between said slidable element and said first member, means for producing a clamping action between said elements in response to movement of said slidable element, and supply means for introducing fluid pressure to said chamber; and

means for measuring loads induced on said specimen.

11. Apparatus for testing a sheet specimen comprising:

a pair of spaced elements;

power means selectively producing relative movement between said pair of spaced elements;

means for clamping portions of said specimen to said spaced elements, including at least one hydraulic clamp comprising a pair of members, at least one of which is connected to one of said spaced elements, and a hydraulic chamber having a slidable element disposed therein drivingly connected to a first one of said members and movable in response to fluid pressure therein, means for producing a clamping action between said elements in response to movement of said slidable element, and supply means for introducing fluid pressure to said chamber means for locking said slidable element against movement in positions in its range of movement; and

means for measuring loads induced on said specimen.

12. Apparatus for testing a sheet specimen comprising:

a pair of spaced elements;

power means selectively producing relative movement between said pair of spaced elements;

means for clamping portions of said specimen to said spaced elements, including at least one hydraulic clamp comprising a pair of members, at least one of which is connected to one of said spaced elements, and a hydraulic chamber having a slidable element disposed therein drivingly connected to a first one of said members and movable in response to fluid pressure therein, means for producing a clamping action between said elements in response to movement of said slidable element, and supply means for introducing fluid pressure to said chamber, and wherein said hydraulic clamp further includes at least one other slidable element and hydraulic chamber, and means drivingly connecting said at least one other slidable element and said first member, and wherein said supply means also introduces fluid pressure to said at least one other fluid chamber.

13. The apparatus of claim 12 further including means providing fluid communication between said fluid chambers.

14. Apparatus for testing a sheet specimen comprising:

a pair of spaced elements;

power means selectively producing relative movement between said pair of spaced elements;

means for clamping portions of said specimen to said spaced elements, including at least one hydraulic clamp comprising a pair of members, at least one of which is connected to one of said spaced elements, and a hydraulic chamber having a slidable element disposed therein drivingly connected to a first one of said members and movable in response to fluid pressure therein, means for producing a clamping action between said elements in response to movement of said slidable element, and supply means for introducing fluid pressure to said chamber, and means for mechanically locking said pair of members against movement relative to each other; and

means for measuring loads induced on said specimen.

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JERRY W. MYRACLE, Primary Examiner

U.S. Cl. X.R.

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