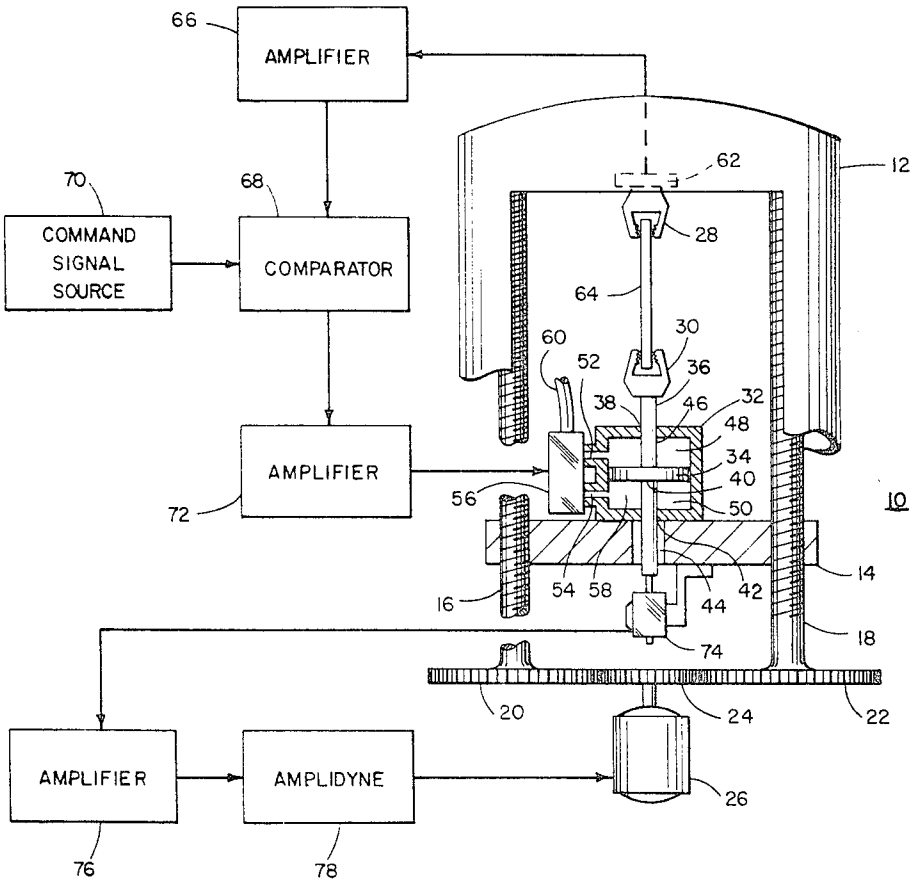
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MOVABLE CROSSHEAD LOADING DEVICE

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MOVABLE CROSSHEAD LOADING DEVICE

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ABSTRACT OF THE DISCLOSURE

Materials testing machine having a hydraulic ram between its movable crosshead and one of two grips, a control system for actuating the ram to adjust a condition of the specimen, and a control system to adjust the crosshead including a sensor for directly sensing the relative positions of the ram and the crosshead.

This invention relates to control systems for materials testing machines having movable crossheads.

It is a primary object of this invention to provide, in such a machine having its crosshead coupled to the movable grip through an hydraulic ram, for a highly accurate and reliable, yet simple system for coordinating ram and crosshead position.

The invention features, in a materials testing machine, a movable crosshead, a pair of grips for holding a specimen to be tested, a drive mechanism for moving the crosshead and a hydraulic ram. The hydraulic ram has a first portion mounted for movement with the crosshead and a second portion coupled to one of the grips and hydraulically coupled to the first portion for movement relative thereto parallel to the crosshead. The ram has a stroke substantially shorter than the overall length of travel of the crosshead. A control system actuates the ram in response to a deviation between the actual and desired position of the grip coupled to the second portion of the ram A, and controls the drive mechanism and ram to restore, after actuation, the relative positioning of the crosshead and second portion of the ram. The control system includes a sensor mounted to directly sense the relative positioning of the crosshead and second portion of the ram.

Other objects, features, and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawing thereof which is a diagram of a materials testing machine with a hydraulic ram and the control system of this invention.

There is shown in the drawing a portion of a materials testing machine **10** having a frame **12**; crosshead **14** driven by motor **26** through screws **16** and **18** and gears **20**, **22**, and **24**; and specimen grips **28** and **30**.

Mounted on crosshead **14** is a hydraulic ram including a hydraulic cylinder **32** and piston **34**. Connecting rod **36**, in fluid-tight, slidable engagement with aperture **38**, conects grip **30** to piston **34**. Rod **40**, in fluid-tight, slidable engagement with aperture **42**, connects to piston **34** and extends through sleeve **44** in crosshead **14**.

Chamber **46** has compartments **48** and **50** on opposite sides of piston **34**. Passages **52** and **54** connect compartments **48** and **50**, respectively, to electrically controlled valve **56** which selectively applies a source of hydraulic pressure to the hydraulic fluid **58** in said compartments. Tube **60** connects valve **56** to a source of hydraulic pressure (not shown).

A load cell **62** senses the load being applied to the specimen **64** by the machine **10** and produces a negative voltage which is introduced through amplifier **66** to an input of comparator **68**. Command signal source **70**,

which may be a manually operated potentiometer circuit, provides a positive voltage indicative of the desired load to be applied to comparator **68**. The output of comparator **68** is delivered through amplifier **72** to valve **56**.

Fastened to crosshead **14** is a linear variable differential transformer (LVDT) **74** which senses the axial movement of rod **40** in relation to crosshead **14**. The output of LVDT **74** is a positive voltage when piston **34** is displaced from its centered position in cylinder **32** toward crosshead **14**; a negative voltage results when piston **34** moves from its centered position towards grip **30**. In either case the output of LVDT **74** controls, through amplifier **76**, the output of amplidyne **78**, which in turn controls motor **26**. A positive output voltage from LVDT **74** causes motor **26** to move crosshead **14** downwardly; a negative voltage to move it upwardly.

In operation, with the machine in a stable state, i.e., with zero output from comparator **68**, a call for an increased load by manipulation of command signal source **70** instantaneously causes a positive voltage to appear at the output of comparator **68**. After being amplified in amplifier **72**, this positive voltage operates valve **56** connecting channel **52** to the source of hydraulic pressure through tube **60**, thereby increasing the pressure in compartment **48** and driving piston **34** downwardly.

The downward movement of piston **34** is sensed by LVDT **74** and causes it to transmit a positive signal representative of the displacement of piston **34** to amplifier **76** and then to amplidyne **78** where it controls the polarity and magnitude of the power to motor **26**. Since the voltage from LVDT **74** is now positive, motor **26** is driven to move crosshead **14** downwardly until piston **34** is once again centered in cylinder **32**.

In a similar manner, a call for a decreased load causes upward movement of piston **34** and corresponding coordination of the crosshead position.

The subject matter discloses above and relating to the use of a hydraulic ram with a crosshead in a materials testing machine is the joint invention of John Linnartz Preston and George Sterling Burr and is the subject of a separate patent application filed the same day as this application.

Other embodiments (e.g. in position control operation) will occur to those skilled in the art and are within the following claims.

I claim:

1. A materials testing machine comprising:
- a movable crosshead,
- a pair of grips for holding a specimen to be tested,
- a drive mechanism for moving said crosshead,
- an hydraulic ram having a first portion mounted for movement with said crosshead and a second portion coupled to one of said grips and hydraulically coupled to said first portion for movement relative thereto parallel to said crosshead,
- a support for the other of said grips,
- a source of hydraulic fluid for said ram,
- a sensor for sensing a condition of said specimen,
- a first control system responsive to said sensor for actuating said ram in response to a deviation between the actual and desired value of said condition, and
- a second control system for actuating said drive mechanism to restore, subsequent to said actuation of said ram, the relative positioning of said crosshead and said second portion of said ram, said control system including a second sensor mounted to directly sense the relative positioning of said crosshead and said second portion of said ram.

2. The machine of claim **1** wherein said second sensor commands said drive mechanism for said crosshead.

3. The machine of claim 2 in which said second sensor is an LVDT, and said first control system further comprises:

an amplifier, responsive to the output of said LVDT, and

an amplidyne, responsive to the output of said amplifier, for controlling said drive mechanism.

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