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HYDRAULIC TESTING MACHINE

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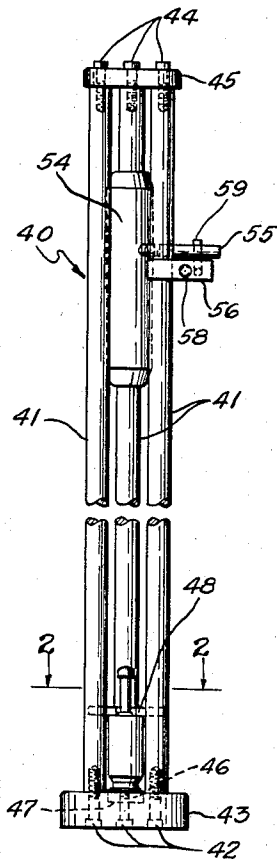


Fig. 1

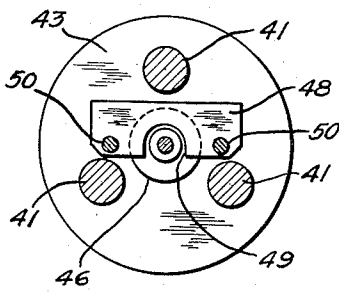


Fig. 2

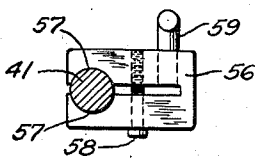


Fig. 3

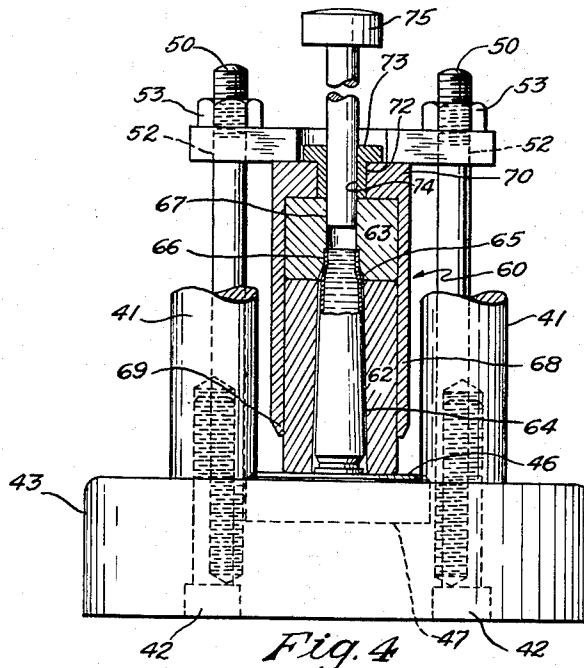


Fig. 4

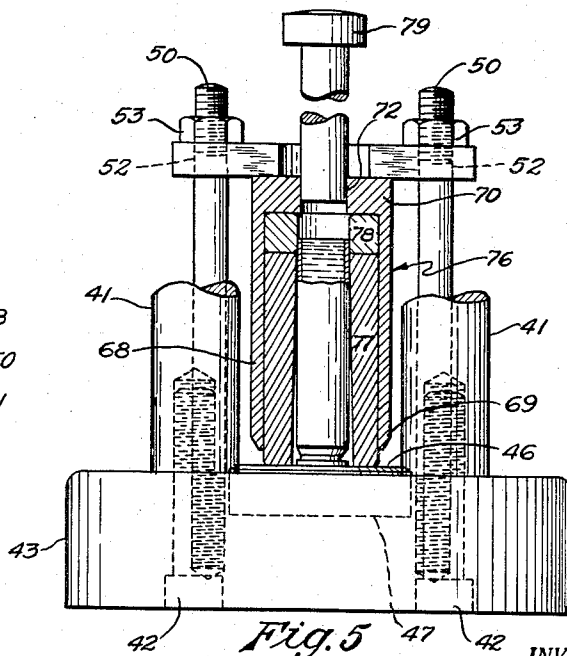


Fig. 5

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HYDRAULIC TESTING MACHINE

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6 Claims. (Cl. 265—14)

This invention relates to material testing machines, and, more particularly, to an improved means for testing tubular articles.

An object of the invention is to provide improved hydraulic means for testing tubular articles. A further object is to determine the quality of cartridge cases by subjecting the case to a test under conditions simulating those prevailing in the chamber of a firearm when a cartridge is fired but without loading the test cases with powder and ball.

Other objects, features and advantages of the invention will be disclosed in the following specification which is descriptive of one embodiment of the invention.

It will be understood, however, that the specific apparatus shown and described is for the purpose of illustration only and that the invention is not limited thereby but includes all embodiments and modifications falling within the scope of the appended claims.

In the drawing:

Fig. 1 is an elevation of the hydraulic testing apparatus of this invention.

Fig. 2 is a plan view on line 2—2 of Fig. 1.

Fig. 3 is a plan view of the weight latching means.

Fig. 4 is an enlarged fragmentary view, partially in section, of the housing used in the apparatus of Fig. 1.

Fig. 5 is a modification of the housing shown in Fig. 3.

Although the present invention relates to an improved means for testing tubular articles of any suitable material or configuration, the particular tubular articles chosen to illustrate the invention are metallic cartridge cases. It will be understood, however, that the apparatus may be adapted for testing tubular articles of other types.

The manufacture of small arms ammunition and ammunition components is an extremely specialized art embodying many exacting requirements of which one of the most severe is the problem of obtaining metallic cartridge cases and especially steel cartridge cases of substantially uniform quality.

As is generally known, a cartridge case is formed from a blank or disk of suitable metal by a series of cupping and drawing operations, suitable heat treatments being made between successive draws in order to soften the metal for additional working. After the final draw, the case has a substantially cylindrical body and a closed somewhat dome-shaped base, the latter being squared up by subsequent operations known as

pocketing and heading. Thereafter the base, now termed the head of the case, is finished in a head turning machine which trims the head to size and forms the extraction groove. The case is thus ready for necking which may be defined as an operation or operations designed to reduce the diameter of the open end of the case and to form the conventional shoulder and tapered body. It will be appreciated, however, that the case has been hardened by the last draw, and, consequently, it is necessary to anneal the upper portion of the case so as to soften the metal prior to the necking operations.

Moreover, this anneal, which is termed the body anneal, has an additional function in that it is designed to build into or contribute to the case those qualities which are essential to its successful performance in the chamber of a firearm. These qualities may be defined as a satisfactory proportioning within the body of the case of certain strength characteristics of the metal, namely yield strength and ductility so that the case may undergo the severe strains to which it is subjected on firing without developing splits or causing cut-offs or other extraction difficulties.

It has been found that these qualities may be obtained by controlling the extent of the anneal or more specifically by limiting the anneal to substantially the upper half of the case, the lower half will be found to have sufficient hardness to obviate hard extractions while the upper half of the case will be soft enough to prevent cut-offs and splits.

The lower limit of the anneal thus becomes a measure of the proportioning of the hard and soft areas in the body of the case and is termed the line of anneal or transformation line. By comparing the location of the transformation line on the body of the test case with a standard measurement, an accurate indication will be had of the quality of the test case.

The present method of determining the quality of a case, and, in particular, an unfinished annealed case by finding the line of transformation is extremely slow and painstaking. Briefly, the test entails a microscopic examination of an etched section of a case to determine the approximate location of a line marking the beginning of crystalline growth in the metal, this line being indicative of the extent of the anneal. At best, this method is tedious and one requiring the laborious preparation of specimens for examination.

A second method of testing cases for proper quality has been to actually fire the loaded case

in a gun. Obviously, this test is not wholly satisfactory since the cases are tested long after a considerable quantity have been finished and loaded. As a result, the test for the quality of the case is made not only extremely remote from the point at which quality was built into the case but also incurs a great waste of ammunition components.

The present invention provides improved means for testing the quality of cartridge cases, namely by subjecting a finished case to pressures simulating those in the chamber of a firearm but without loading the case with powder and ball.

Referring to the drawing, Figs. 1 to 5 show one form of apparatus designed and constructed for subjecting finished cartridge cases to pressure comparable to the pressures existing in the chamber of a firearm when a cartridge is fired.

In Fig. 1, the apparatus shown comprises a composite column indicated generally at 40 consisting of three posts 41 secured by suitable screw bolts 42 vertically on a disk shaped base 43 in substantially equally spaced relationship, as shown in Fig. 2, the upper ends of the posts being similarly secured by screw bolts 44 to a head plate 45. A hardened steel block or anvil 46 is seated in a concentric recess 47 in the base block 43, the anvil being adapted to support a cartridge case housing which, as hereinafter described, is held substantially rigidly on the anvil by means of an adjustable yoke 48.

The yoke 48 comprises a substantially flat rectangular steel plate having a U-shaped aperture 49 in one edge and is adapted to be supported symmetrically with respect to the vertical axis of the base 43 by a pair of posts 50 which are suitably secured to the base 43 on diametrically opposite sides of the anvil 46. The posts 50 project through suitably drilled holes 52 in opposite ends of the yoke 48 and are screw threaded at their upper end, as shown in Fig. 4, to accommodate nuts 53 for adjusting the height of the yoke with respect to the base.

Suitable means for transmitting a sudden blow to a liquid filled test case comprises a suitable weight 54 mounted to slide within the column defined by the three spaced vertical rods 41, the latter constituting, in effect, means for guiding the weight. The latter is adapted to be raised by a suitable handle 55 which is shown threadedly secured at one end to the weight adjacent the upper end thereof.

Suitable means for latching the weight in its uppermost position, see Fig. 3, comprises a split block 56 having a pair of oppositely disposed semicircular apertures 57 in adjacent arms adapted to cooperatively embrace one of the guide posts 41 and to be drawn into rigid engagement therewith by a bolt 58 threadedly secured in the adjacent arms of the split block. A pin 59 projects laterally and upwardly at substantially forty-five degrees from the side of the block 56, thus providing a fixed rest or hook for the handle 55.

The means for supporting a cartridge case to be tested comprises a housing indicated generally at 60 consisting of two separable dies 62 and 63 encased within a holder 68.

The die or chamber 62 comprises a heavy walled substantially cylindrical block having a tapered bore 64, the diameter and taper of which are critical. As explained above, this testing device is constructed and arranged to provide for the expansion of a finished and tapered cartridge case to substantially the same extent suffered by a loaded cartridge when fired in a chamber of a

gun. To provide for this expansion, the measurements of the bore 64 of the chamber 62 simulate or are made substantially equal to the measurements of the bore of a gun chamber, preferably a worn chamber, at the instant of maximum expansion, or, in other words, the bore 64 of the chamber 62 has the maximum dimensions, including head space, to which any case may be expected to expand when actually fired. Consequently, any test case which withstands the maximum expansion suffered in the test chamber 62 without developing splits or becoming permanently set, will have and will be indicative of those quality characteristics in similarly processed finished cases, which are necessary for satisfactory performance in the chamber of a firearm.

The member 63 comprises a heavy walled cylindrical shoulder die adapted to be superposed on the upper end of the die or chamber 62 in the manner shown in Fig. 4. The shoulder die has a tapered bore 65 at its lower end, the slope of which parallels that of the shoulder portion of a finished cartridge case when mounted in the chamber 62 but which is spaced therefrom, as shown, to provide for maximum head space such as would be encountered in a worn gun chamber. Thus, when the test case expands in the dies 62 and 63, the shoulders as well as the body of the case, are tested for quality under conditions simulating actual firing conditions. The upper end of the tapered bore 65 of the shoulder die merges into a cylindrical bore or constriction 66, the diameter of which is substantially equal to the outside diameter of the mouth of the finished case, the function of the constriction 66 being to support and reinforce the walls of the mouth portion of the case and thereby prevent the untimely collapse of the mouth of the case. The constriction or bore 66 is reduced by means of a slightly tapered shoulder to form a cylindrical bore 67, the diameter of which is substantially equal to the inside diameter of the mouth of the case. The slightly tapered shoulder serves as an abutment for the upper end of the case while the constricted bore 67 form a seal, with a plunger hereinafter described, for preventing the escape of liquid from the test case when it is subjected to high pressures.

The hollow cylindrical die holder 68 comprises suitable means for facilitating assembly of the separable dies 62 and 63 of the compound housing 60. The holder is provided with an open lower end 69 in order that the holder may be slipped down over the superposed dies and has a head portion 70. The latter is provided with a drilled hole 72 substantially in axial alignment with the holes of the assembled dies 62 and 63 and is of sufficient diameter to receive a flanged collar 73, the bore 74 of the latter being concentric with the drilled hole 72 of the holder 68. The diameter of the bore 74 is substantially equal to the diameter of the stem of a suitable plunger 75 and forms a bushing therefor, the plunger 75 being adapted to move down into the mouth of the test case and compress the liquid therein when struck by the freely falling weight 54.

In use, a finished cartridge case to be tested is filled with liquid and placed, as shown in the lower die or chamber 62 which is mounted on the anvil 46. The upper die 63 is then pressed down over the upstanding mouth and shoulder portions of the case, some force being necessary

due to the relatively close fit between the mouth portion of the case and the adjacent walls of the bore 66.

Thereafter the die holder 68 is slipped over the superposed dies and the entire assembly secured on the anvil by the yoke 48 which is drawn down on top of the holder 68 by the nuts 53. The plunger being in position, the weight is then released and drops down onto the plunger striking it with sufficient force to abruptly expand the case within the housing into conformity with the bores of the dies 62 and 63.

As a result, the test case is swelled to the maximum size to which any case could expand in the chamber of a firearm. If, in removing the case from the housing, the case does not stick but is readily removable by a normal pull of the order of five to seven pounds then cases of the same quality will not provide extraction difficulties when actually loaded and fired. Moreover, if the test case is not split then it is not likely that cases similarly processed will develop cut-offs or ruptures when fired in the gun.

Although the apparatus shown in the drawing is adapted specifically to test the quality of finished cases having tapered bodies and shoulder and mouth portions, it will be clear that other dies corresponding to the body and shoulder dies 62 and 63 may be substituted therefor having bores of different size and shape to accommodate test cases at different stages of processing. For example, in Fig. 5, is shown a modification of the apparatus of Fig. 4, wherein the housing indicated generally at 76 comprises the holder 68 and two separable dies 77 and 78 having axially aligned bores suitably shaped to receive a substantially cylindrical case such as one processed to have the body anneal referred to above. Since the open end of the cylindrical test case is of greater diameter than that of the mouth of a tapered test case, a plunger of larger diameter such as shown at 79 must be used to form a liquid seal with the walls of the open end of the cylindrical case. By removing the bushing 73 from the drilled hole 72 in the head end of the holder 68, see Fig. 4, a larger hole of the correct diameter is provided for the larger size plunger 79. The hydraulic test is made on the cylindrical case in substantially the manner described above and a deformation will be formed on the annealed body portion of the case which terminates in a well defined shoulder indicating the location of the line of transformation or anneal line. By slipping a ring gauge over the head of the swelled case and moving the gauge up against the shoulder a measure may then be obtained of the location of the anneal line. It will be evident, therefore, that by a simple substitution of die and plungers, the apparatus may be adapted to test both cylindrical and tapered cases.

What is claimed is:

1. Hydraulic testing apparatus comprising a base; a housing mounted on said base, said housing comprising separable dies having axially aligned bores for supporting a liquid containing tubular article with its open end uppermost, the bore of the upper die having a constriction for confining the upper end of the article, the bore of the lower die being of greater diameter than the diameter of the lower portion of the article, and a die holder for aligning said separable dies; a plunger adapted to be mounted in the bore of the upper die and movable therein into the mouth

of the liquid filled tubular article; and an impact delivering means supported above said plunger and adapted to be released to strike said plunger with a force of such magnitude as to develop hydraulic pressure sufficient to deform that portion of said article housed within the lower die.

2. Hydraulic testing apparatus comprising a base; a housing mountable on said base, said housing comprising superposed separable dies having axially aligned bores for supporting a liquid containing cartridge case with the mouth portion uppermost, the bore of the upper die having a constricted portion adapted to confine the mouth of said case, and a tapered portion dimensioned so as to be spaced from the shoulder of said case, the bore of the lower die being of greater diameter than the diameter of the body portion of the case; a plunger adapted to be mounted in the bore of the upper die and movable therein into the mouth of the liquid filled case; and an impact delivering means supported above said plunger and adapted to be released to strike said plunger with a force of such magnitude as to develop hydraulic pressure sufficient to expand the shoulder and body portions only of the case in conformity with the upper and lower dies respectively.

3. Hydraulic testing apparatus comprising a base; a housing mountable on said base, said housing comprising two superposed separable dies having axially aligned bores for supporting a liquid containing cartridge case with the mouth portion uppermost, the bore of the upper die having a constricted portion adapted to confine the mouth of said case, the bore of the lower die being tapered and of greater diameter than the body portion of the case; a plunger adapted to be mounted in the bore of the upper die and movable therein into the mouth of the liquid filled case; and an impact delivering means supported above said plunger adapted to be released to strike said plunger with a force of such magnitude as to develop hydraulic pressure sufficient to deform the body portion of the case substantially in conformity with the bore of the lower die.

4. Hydraulic testing apparatus comprising a base having an anvil; a slotted column mounted on said base comprising equally spaced substantially vertically disposed guide rods; a housing mountable within said column on said anvil, said housing comprising two superposed dies having axially aligned bores for supporting a liquid containing cartridge case with its mouth portion uppermost, said bores being provided with a constriction for confining a limited portion of said case and an unconstricted portion to enable expansion of the unconstricted portion of said case; a plunger adapted to be mounted in the bore of the upper die and movable therein into the mouth of the liquid filled case; means for delivering a sudden blow to said plunger comprising a freely falling weight constructed and arranged to be supported at the upper end of said column in axial alignment with said plunger; and a handle on said weight elevating means adapted to be guided in one of the slots of said column.

5. Hydraulic testing apparatus comprising a base having an anvil; a slotted column mounted on said base comprising equally spaced substantially vertically disposed guide rods; a housing mountable within said column on said anvil, said housing comprising two superposed dies having axially aligned bores for supporting a liquid con-

taining cartridge case with its mouth portion uppermost; a plunger adapted to be mounted in the bore of the upper die and movable therein into the mouth of the liquid filled case; means for delivering a sudden blow to said plunger comprising a freely falling weight constructed and arranged to be supported at the upper end of said column in axial alignment with said plunger; weight elevating means adapted to be guided in one of the slots of said column; and means secured to said base for securing said superposed dies to said anvil.

6. In testing apparatus for a liquid filled cartridge case, a housing for said case comprising two superposed dies having axially aligned bores, 15

the bore of the lower die being shaped and having dimensions substantially equal to those of the worn chamber of a firearm when expanded to its maximum size by a force comparable to the 5 force of explosion of a cartridge suitable for said chamber and of greater diameter than the diameter of the body portion of a standard cartridge case, the bore of the upper die having a constriction adapted to confine the mouth of a 10 case supported within said housing; and hydraulic means for expanding the body portion of the liquid filled case into conformity with the bore of the lower die.

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