

Jan. 21, 1947.

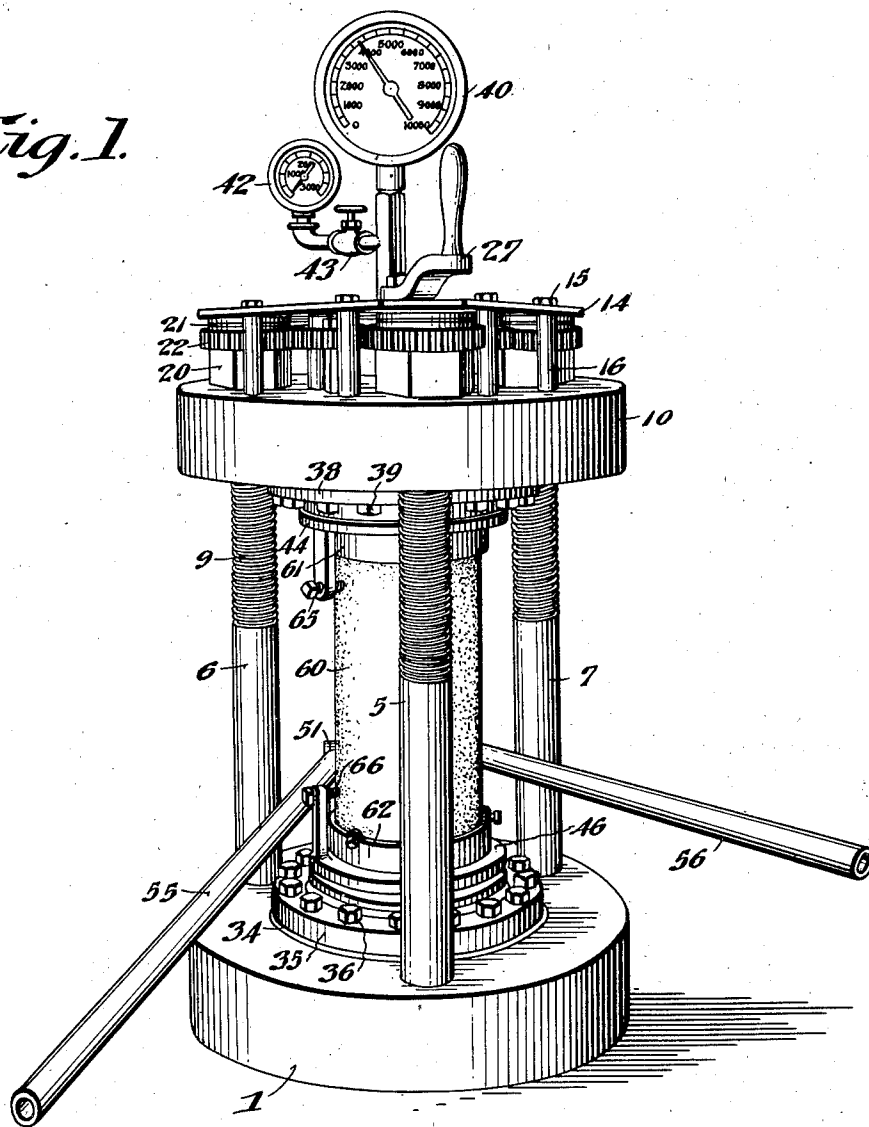
O. G. PATCH
COMPRESSION MACHINE

2,414,550

Filed Feb. 13, 1943

4 Sheets-Sheet 1

Fig. 1.



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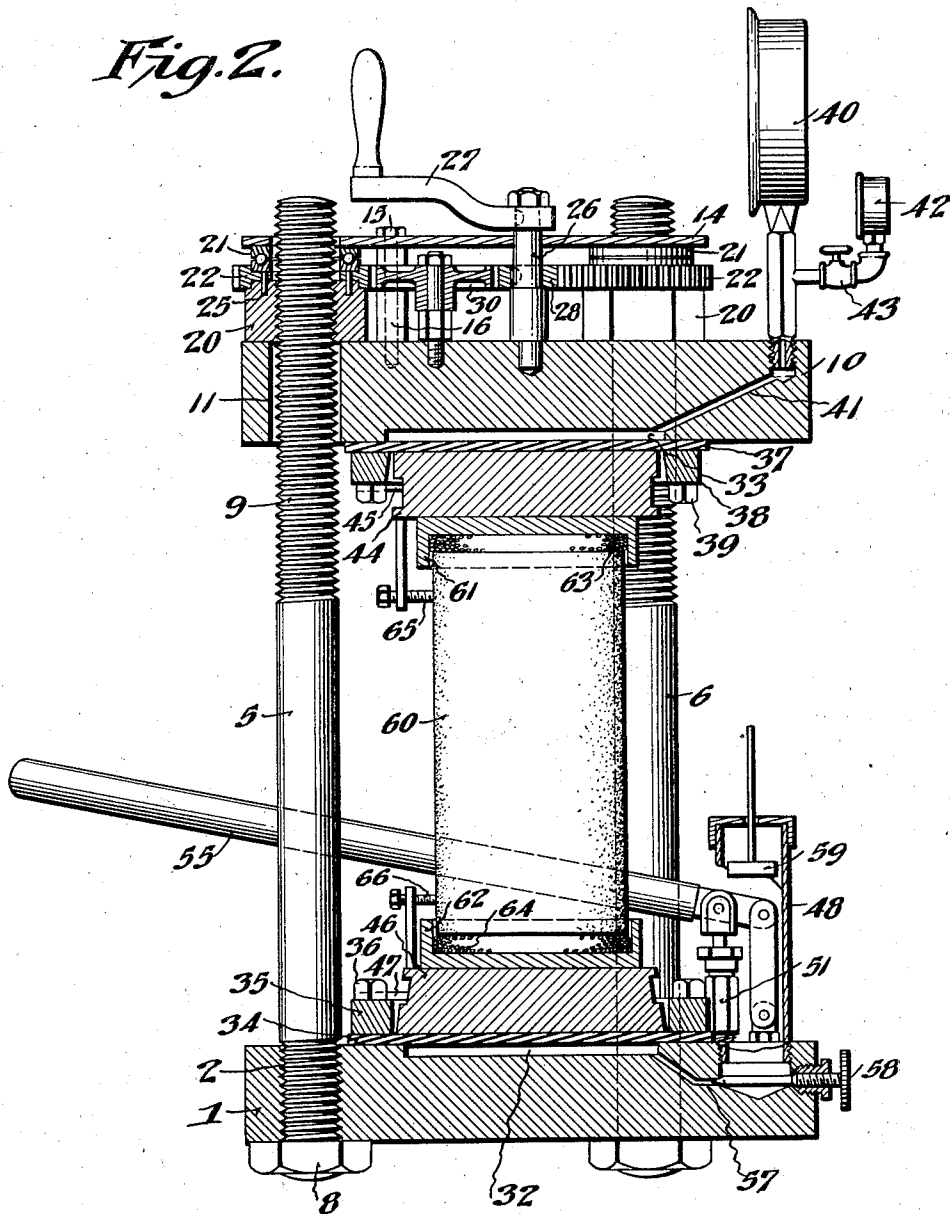
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4 Sheets-Sheet 2

Fig. 2.



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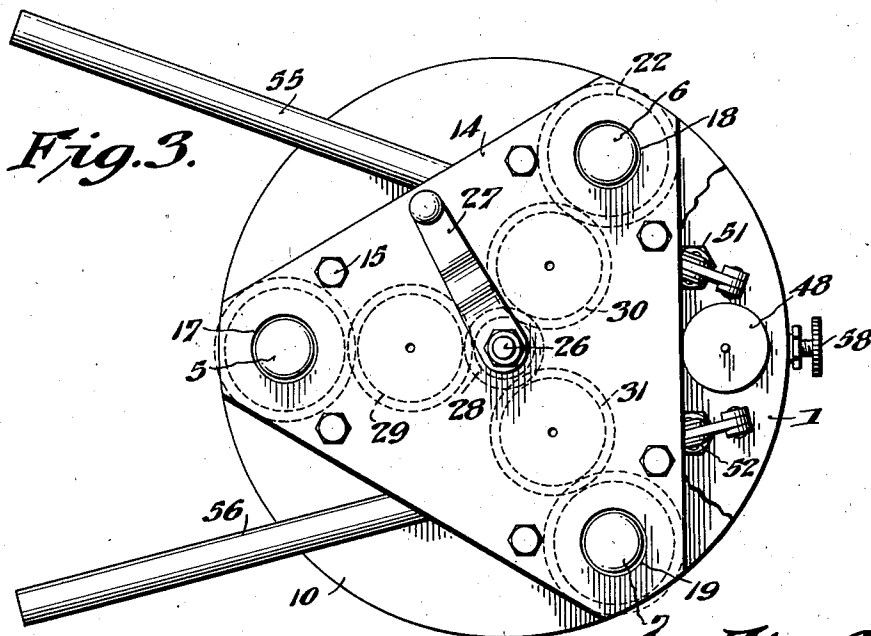
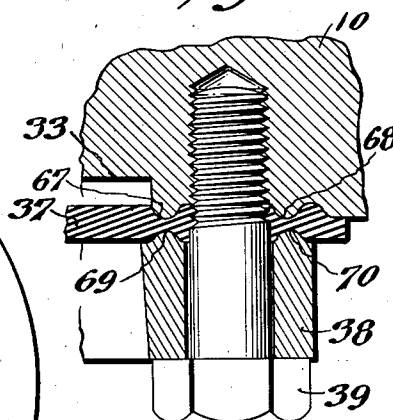
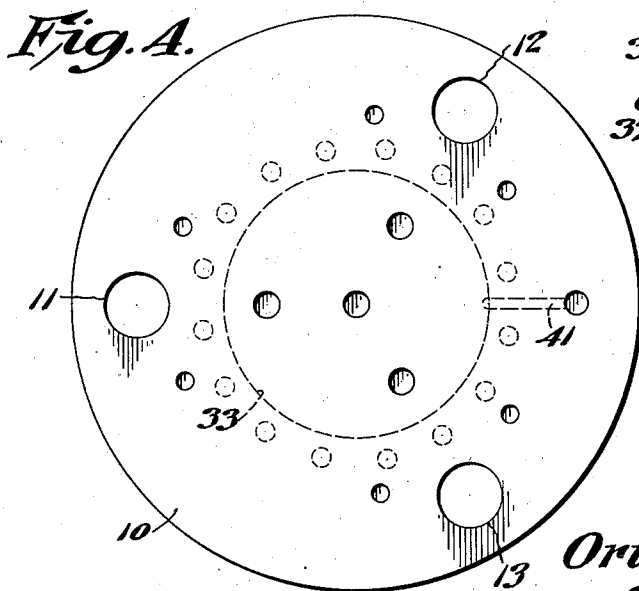


Fig. 6.



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Fig. 5.

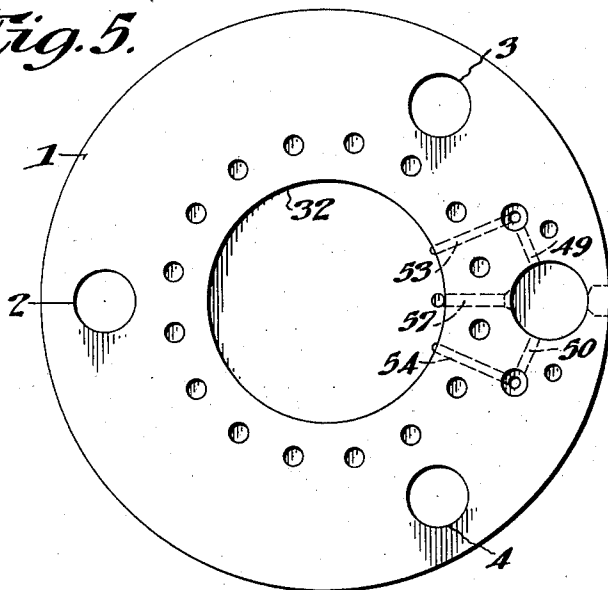


Fig. 7.

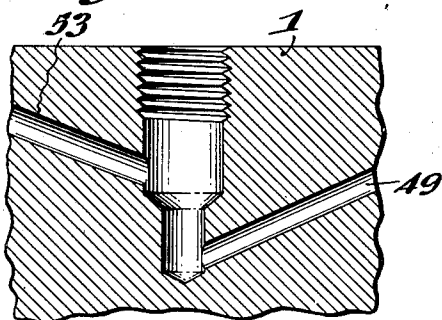


Fig. 8.

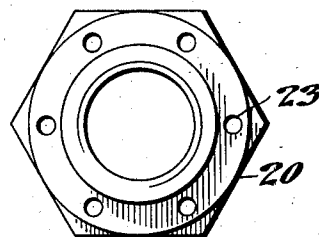


Fig. 9.

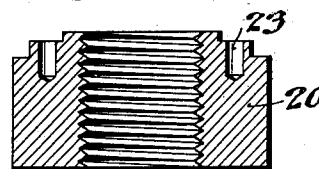
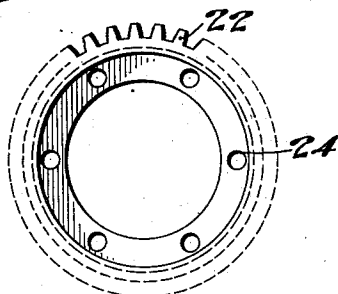


Fig. 10.



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UNITED STATES PATENT OFFICE

2,414,550

COMPRESSION MACHINE

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Application February 13, 1943, Serial No. 475,815

20 Claims. (Cl. 73—94)

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My invention relates to improvements in compression machines, and particularly to a machine intended and adapted for testing the compressive or crushing strength of columnar or other test specimens of concrete, stone, or other breakable materials.

An object of my invention is to provide a machine that is light to the point of being readily transportable, can be simply and cheaply constructed, is easily operated by application of only manual force, or light power equipment, to attain high pressures and apply compressive forces sufficient to stress the specimen to failure to obtain a true record of the pressure applied, free from uncertainties as to loss due to friction in pistons or other mechanism, and which also has other desirable characteristics not found in other types and combinations of machines as heretofore employed.

Another purpose is to so construct the parts that the compression force is applied to the specimen through opposed compression portions by parts floating or supported on a fluid well whereby these parts are readily and freely movable to automatically adjust and adapt to the angle of the ends of a test specimen, thus assuring a uniform and uniformly distributed fluid pressure over the entire area of the compression portion and avoiding lateral stresses that might otherwise occur if the plane at either end of the test specimen is not exactly normal to its longitudinal axis and the force is applied through a bearing that remains normal to its line of movement.

Another object is to provide a machine of this character in which initial movement or adjustment of the parts to the force applying or stressing positions is readily and quickly accomplished by manual manipulation of mechanically operating parts, following which very high pressures are obtained with a minimum of effort or work, through accumulation of compressive fluid forces by the use of small readily manually operable pumps, or light power mechanism.

Still another object is to provide a machine of this type in which a relatively small amount of fluid is employed without the use of pistons with rings or packings or other parts that might generate friction or allow leakage of fluid, and which requires only a few hundredths of an inch or other very slight fractional movement, readily generated through manual manipulation of the pumps, to apply exceedingly high pressures sufficient to stress a specimen to failure, and in fact pressures much higher than can be ordi-

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narily accomplished by mechanical application of force or load, with a similar amount of work with other machines.

Yet another purpose is to provide a machine of this character in which determinations of the force required to stress the specimen to failure can be ascertained by indications of the fluid pressure applied to or accumulated from the compressive force borne between the opposed compression portions of the specimen, thus permitting showing or translation of the actual fluid pressure to indicate the pounds per square inch of the specimen being tested, or any other desired information or data.

With the above and other objects in view, some of which will be apparent to those skilled in the art and others of which are inherent in the construction and operation and use of the apparatus, my invention includes certain novel features of construction and combinations and arrangements and associations of parts which will be set forth in connection with the drawings and then pointed out in the claims.

In the drawings:

Figure 1 is a view in perspective showing a machine constructed in accordance with my invention.

Fig. 2 is a vertical sectional view.

Fig. 3 is a top plan view of the machine.

Fig. 4 is a top plan view of the upper plate.

Fig. 5 is a top plan view of the lower base or supporting plate.

Fig. 6 is an enlarged fragmentary sectional view showing fluid confining construction.

Fig. 7 is an enlarged fragmentary sectional view showing one of the pump connections and associated fluid ducts.

Fig. 8 is a top plan view of one of the adjusting nuts.

Fig. 9 is a vertical sectional view through the adjusting nut.

Fig. 10 is a view in elevation of one of the adjusting nut driving gears.

A supporting base plate 1, which is of sufficient size and thickness and mass to support the loads or stresses to which the machine will be subjected has the threaded openings 2, 3 and 4 formed therethrough and preferably spaced substantially equally outwardly toward the periphery to thus leave the middle area of this base supporting plate unobstructed. Supporting standards or rods 5, 6 and 7 are screw-threaded at their lower ends to fit and be tightened within these openings 2, 3 and 4, and nuts 8 are preferably tightened onto the lower ends of these

uprights or rods to thus rigidly and fixedly secure the several rods 5, 6 and 7 in upright substantially parallel extension with respect to the supporting and base plate 1.

The upper ends of the several uprights or rods 5, 6 and 7 are externally screw-threaded, as at 9, for a length sufficient to provide for an appreciable length of an adjusting screw; and, an upper plate member 10 is movably mounted on the several rods and is held in desired spaced relation with respect to the supporting base plate or member 1 by adjusting means, which will be hereinafter more fully described, working upon the screw-threaded portions 9.

The upper plate or member 10, as perhaps best shown in Fig. 4, has openings 11, 12 and 13 there-through of size and spacing to slidably receive the threaded portions 9 of the uprights or rods 5, 6 and 7, and a supporting frame plate 14 mounted on the top of and spaced above said upper plate or member 10, through the medium of cap bolts 15 and spacing sleeves 16, has registering openings 17, 18 and 19 adapted to also slidably receive the threaded portions 9 of the uprights or rods 5, 6 and 7.

Adjusting nuts 20, one of which is shown in greater detail in Figs. 8 and 9, are turned onto the threaded portions 9 of the several uprights or rods 5, 6 and 7, with their lower faces bearing against the upper side of the upper plate or member 10. Ball bearings 21 can be interposed between the supporting frame plate 14 and the adjusting nuts 20 to reduce friction. Adjusting gears 22, one of which is shown in greater detail in Fig. 10, are mounted and fixedly held on each of the adjusting nuts 20, and in the present instance I have shown the nuts 20 as provided with pin receiving openings 23 and the adjusting gears 22 as having registering openings 24 adapted to receive pins 25 by which the adjusting clamping nuts and the gears are substantially fixedly connected to revolve together. An operating spindle 26 is revolvably mounted in substantially centered relation between the upright rods 5, 6 and 7, and an operating crank handle 27 is provided for manual rotation of this operating spindle 26. An operating gear 28 is fixed on the operating spindle 26 to rotate therewith, and transmission gears 29, 30 and 31 are revolvably mounted around this operating gear 28 and in mesh therewith, and also in mesh with the adjusting gears 22 for the several adjusting nuts 20 of the upright rods 5, 6 and 7. With the adjusting parts as just described, rotation of the operating spindle 26 through the medium of the operating crank 27 will cause simultaneous rotation of the adjusting nuts 20 on the upright rods 5, 6 and 7, so that the upper plate or member 10 can be thus manually raised and lowered with respect to the supporting base plate or member 1 and the parallelism of the opposed faces thereof will be maintained.

The supporting base plate or member 1 has a fluid well 32 in the upper face thereof, and a fluid well 33 is provided in the lower face of the upper plate or member 10. A diaphragm 34 is secured over the fluid well 32 by a clamp ring 35 held in place by cap screws 36, and the fluid well 33 has a similar diaphragm 37 secured over the open side thereof by clamp ring 38 held in place by cap screws or bolts 39. A pressure gauge 40 is carried by the upper plate or member 10 in position to be readily visible to the user or operator of the machine, and a fluid duct or passage 41 establishes communication from the

fluid well 33 to this pressure gauge 40. The fluid gauge 40 can be marked or calibrated to indicate fluid pressure or to translate into pounds per square inch or other compression force indications; and, a second fluid operating gauge 42 can be connected in any desired manner to be responsive to fluid pressure within the chamber 33. In the present instance I have shown this second fluid gauge 42 as having connection with the fluid duct or passage 41 and have illustrated a valve 43 inserted for opening and closing the line. A pressure plate 44, of less diameter than the transverse measurements of the fluid well 33 is disposed on the outer side of the diaphragm 37 and is held movably in place by clips 45, and is free to tilt.

A pressure plate 46 is disposed on the outer side of the diaphragm 34, to be tiltably movable within the opening of the ring 35, under increases of fluid pressure in the well 32 causing distending of the diaphragm 34, and this pressure plate 46 can be held against removal by clips 47. In the use of the machine stressing force upon the specimen will be accomplished by increasing the fluid pressure in well 32, and this pressure can be built up through increase in liquid or gaseous or other suitable fluid pressures. In the present instance I have illustrated a liquid reservoir 48 as carried at one side of the supporting and base plate 1 with liquid passages 49 and 50 leading therefrom to compression pumps 51 and 52 which are connected with the fluid well 32 by liquid passages 53 and 54. These liquid pumps 51 and 52 can be of any desired or suitable construction that will supply to the well 32 through the passages 53 and 54 liquid under pressure as taken through the passages or ducts 49 and 50 from the reservoir 48, and in the present instance these pumps are illustrated as being of the piston type with operating handles 55 and 56 extending in spaced relation so that the operator or user can grasp a handle in each hand and can by manual manipulation supply liquid or fluid from reservoir 48 under pressure to the fluid well 32, thereby expanding the diaphragm 34 to exert upward pressure through pressure plate 46. To permit release of pressure, a return fluid passage 57 is provided from fluid well 32 to the reservoir 48, and a valve 58 is provided to control this return passage. A float actuated or other indicating means 59 can be provided to indicate or show the level of liquid within the reservoir 48.

In the present instance I have shown the specimen 60 as being of substantially cylindrical columnar form, as for instance a test cylinder specimen substantially six inches by twelve inches, such as is commonly employed in specimen testing of concrete and other materials. With such a specimen the ends are presented as opposed compression portions, and I have here shown shot caps 61 and 62 fitted upon the ends of the test specimen 60, it having been found that such caps having shot or other movable pellet-like particles therein as at 63 and 64 will uniformly distribute the pressure upon the compression portions of the specimen 60. These shot caps 61 and 62 are thus presented to engage the outer opposed faces of the pressure blocks 44 and 45. Any other standard method of capping may be used. To substantially center and align the specimen 60, centering screws 65 and 66 can be provided on arms or supports carried by the pressure blocks 44 and 45.

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To insure fluid-tight connection and mounting of the diaphragms 34 and 37 over the open outer sides of the fluid wells 32 and 33, the gripping or clamping portions of the clamp rings and the plates can be shaped to bite upon or grip the edges of the diaphragms, somewhat after the manner shown in Fig. 6, where the plate 10 has annular ribs or bead-like formations 67 and 68 and intermediate grooves against which the diaphragm 37 fits, the ring 38 being also provided with annular ribs or bead-like portions 69 and 70 so that the edge portion of the diaphragm is clamped and is securely held against likelihood or possibility of being displaced or of yielding to permit fluid leakage.

In the use of my improved machine, the adjusting crank handle 27 will be manually operated to turn the adjusting nuts 20 to unscrew the same with respect to the several upright rods 5, 6 and 7, so that the upper movable plate or member 10 is raised sufficiently to permit placement of the specimen 60 between the pressure plates 44 and 46. By reverse manipulation of the adjusting crank handle 27, the adjusting and clamping nuts 20 are screwed onto the rods 5, 6 and 7 at uniform speed and the upper plate or member 10 is moved down to engage the opposed compression portions of the specimen 60 between the outer sides of the pressure plates 44 and 46. Since the adjusting nuts 20 are rotated simultaneously and at the same speed, the upper movable plate or member 10 will be at all times maintained in a parallel plane with respect to the base or supporting plate 1; and, since this mechanical adjustment is only an initial adjustment and is not intended for application of maximum specimen stressing pressure, the friction of the adjusting nuts 20 on the threaded portions 9 of the rods 5, 6 and 7 will be substantially negligible. Further, the antifriction bearings at 21 will tend to relieve and obviate any possibility of objectionable frictional forces or resistances.

After the upper movable plate or member 10 has been thus mechanically and manually adjusted through the initial stage, the operator can manipulate the handles 55 and 56, thus actuating the pumps 51 and 52 and supplying fluid from reservoir 48 through passages or ducts 53 and 54, under uniformly increasing pressure, to the fluid well 32. With the initial adjustment attained through the adjusting nuts 20, it will require only a few hundredths of an inch upward movement of pressure plate 46 to stress the specimen to failure, and since well 32 is fluid tight, the pumps 51 and 52 can consequently be small in diameter, and a very high pressure can be obtained and applied to the specimen with a minimum of manual effort or work. When the pressure within fluid well 32 is thus increased, diaphragm 34 is distended to exert compression force through pressure plate 46 to the lower end of the specimen 60, and this force is transmitted through the specimen and through opposed compression portions thereof to pressure plate 44. Since pressure plate 44 is smaller than the opening of fluid well 33, the diaphragm 37 will be compressed into the fluid chamber 33, thereby increasing the pressure of fluid confined within this fluid well 33 and transmitting the fluid pressure to one or both fluid actuated gauges 40 and 42. The pressure plates 44 and 46 are freely tiltable within the clamping rings 38 and 35, and there will consequently be no binding or frictional losses, nor can there be leakage of fluid from either of the fluid wells.

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With the test conducted in the manner set forth, readings or indications can be observed on one or both of the fluid actuated gauge or indicating means 40 and 42, and in some instances it may be desirable to have the gauge means 42 for more accurately indicating the lower pressures with the gauge 40 constructed and adapted to indicate higher pressures when valve 43 is closed, and with the two gauges available for checking of one against the other to obviate errors due to one or the other of the gauges becoming inaccurate. Upon completion of the test, valve 58 can be manipulated to open the discharge through passageway 57 and liquid or fluid in fluid chamber 32 will then flow back into reservoir 48, relieving the pressure and making it possible for the operator to freely manipulate the adjusting nuts 20 through actuation of the adjusting crank handle 27. Should the ends of the specimen be not in exactly parallel planes, or either end be at an angle with the normal to the axis of the cylindrical specimen, the fluid wells and the flexible diaphragms permit the pressure plates 44 and 46 through which the compression force is transmitted to the specimen to conform to the angle of the ends or compression portions without appreciable strain, and the applied pressure is henceforth uniformly distributed over the two end areas, thus insuring against localized or unequal application of stressing force. It will be appreciated that the diameter of the upper compression plate 44 may be such that its area is just double that of the six inch diameter test specimen, in which case and proportion the pressure operated gauge structure may be calibrated so that it reads double the actual fluid pressure per square inch, and then the resulting gauge reading will be the actual load per square inch as exerted upon or borne by the six-inch diameter specimen. For specimens of other diameters and shapes or forms, conversion charts or calibrations or a simple computation is all that will be necessary to give the converted pressure in pounds per square inch. Obviously, the fluid operated gauge structures 40 and 42 can be calibrated in various other manners and to any desired unit or measurement.

While I have herein shown and described only certain specific embodiments of my invention and have set forth only certain possible uses and have suggested only certain specific changes, it will be appreciated that many changes can be made in the form, construction and assembly of the parts and in the manner of using the machine and of computing or measuring to attain any desired result, without departing from the spirit and scope of my invention.

I claim:

1. In a compression machine adapted for use upon a specimen having opposed compression portions, a flexible yieldable fluid sustained disc-like diaphragm, means tiltably supported by said diaphragm and adapted to receive and angularly conform to one compression portion of a specimen, means to apply compression load to the specimen, and means to measure the compression force applied to the specimen.

2. In a compression machine adapted for use upon a specimen having opposed compression portions, a fluid well, a disc-like diaphragm closing said fluid well, means tiltably supported by said diaphragm and adapted to receive and angularly conform to one compression portion of a specimen, means to apply compressive force through the opposed compression portions of the

specimen, and means to indicate fluid pressure within the well resulting from compressive force exerted upon the diaphragm.

3. In a compression machine, means whereby compression portions of a specimen to be tested are held between two members tiltably held upon flexible diaphragms which are supported on fluid wells, means to apply pressure to the specimen through increase of fluid pressure in one of said wells, and means to indicate the pressure so applied.

4. In a compression machine adapted for use upon a specimen adapted to be held between opposed compression portions, means tiltably held upon a yieldable fluid sustained flexible diaphragm adapted to receive and angularly conform to one of the compression portions of the specimen a support for the other compression portion, and means to increase the fluid pressure on the inner side of the diaphragm and consequently on the specimen.

5. In a compression testing machine adapted for testing a specimen having opposed compression portions, two spaced apart yieldable fluid sustained diaphragms having supported thereby tiltably means adapted to receive and angularly conform to the opposed compression portions of the specimen, means to increase the fluid pressure back of one of said fluid sustained diaphragms, and means to measure the compression force applied to the specimen.

6. In a compression testing machine adapted for testing a specimen having opposed compression portions, a pair of spaced fluid wells, flexible yieldable diaphragms closing said fluid wells, means tiltably supported by said diaphragms to bear against the compression portions of the specimen and give an angle conforming floating mounting of said specimen, and means to apply compression force to said specimen between the diaphragms.

7. In a compression testing machine adapted for testing a specimen having opposed compression portions, a pair of spaced fluid wells, flexible yieldable diaphragms closing said fluid wells, means tiltably supported by said diaphragms to bear against the compression portions of the specimen and give an angle conforming floating mounting of said specimen, means to apply compression force to said specimen between the diaphragms, and means measuring through the fluid pressure the compression force applied to the specimen.

8. In a compression testing machine adapted for testing a specimen having opposed compression portions, a pair of spaced fluid wells, flexible disk-like diaphragms closing said fluid wells and adapted on their outer middle portions to bear the force of compression portions and give a floating mounting of said specimen, means to increase the fluid pressure at one diaphragm, and means to measure through the increase of fluid pressure at the other diaphragm the compression force applied to the specimen.

9. In a compression testing machine adapted for testing a specimen having opposed compression portions, a supporting structure, fluid wells carried by said supporting structure in spaced relation, flexible disk-like diaphragms closing said fluid wells and adapted on their outer middle portions to bear the force of the compression portions of a specimen being tested, means to increase the fluid pressure behind one of said diaphragms, and means to indicate the resultant

variation in fluid pressure behind the other diaphragm.

10. In a compression testing machine adapted for testing a specimen having opposed compression portions, a supporting structure, spaced fluid wells adjustably carried by said supporting structure, means for varying the spaced relation of said wells, diaphragms closing said fluid wells, bearing members carried on the outer middle portions of said diaphragms and spaced apart a distance to bear the opposed compression portions of the specimen, and means to measure through the fluid pressure increase behind one of said diaphragms the compression force applied to the specimen.

11. A compression testing machine adapted for testing a specimen having opposed compression portions comprising a base plate, an upper plate, means holding said plates in spaced facing disposition, fluid wells in the opposed faces of said plates, diaphragms closing the outer sides of said fluid wells, means to move said plates relatively to support the force of the compression portions of the specimen upon said diaphragms, and means to measure through the fluid pressure increase behind one of said diaphragms the compression force applied to the specimen.

12. A compression testing machine adapted for testing a specimen having opposed compression portions, comprising a base plate, an upper plate, means holding said plates in spaced facing disposition, fluid wells in the opposed faces of said plates, diaphragms closing the outer sides of said fluid wells, means to move said plates relatively to support the force of the compression portions of the specimen upon said diaphragms, means to increase the fluid pressure behind one of said diaphragms with consequent increase of compression force upon the specimen, and means to measure through the increase of fluid pressure the compression force applied to the specimen.

13. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper face thereof, guide rods rising from said base plate around the well, an upper plate movable on said guide rods and provided with a fluid well on its under face, diaphragms closing the outer sides of said fluid wells, the wells being of greater diameter than corresponding diameter of the compression portions of the specimen, means on said rods for moving the upper plate toward the base plate and thereby exerting compressive force on said specimen between the diaphragms, and means measuring through the increase of fluid pressure the compressive force applied to the specimen.

14. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper face thereof, guide rods rising from said base plate around the well, an upper plate movable on said guide rods and provided with a fluid well on its under face, diaphragms closing the outer sides of said fluid wells one or both of the wells being of greater diameter than corresponding diameter of the compression portions of the specimen, means on said rods for moving the upper plate toward the base plate and thereby exerting compression force on said specimen between the diaphragms, means to increase the fluid pressure behind one of said diaphragms, and gauge means actuated

by variations in the fluid pressure to indicate compression force applied to the specimen.

15. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper face thereof, guide rods rising from said base plate around the well, an upper plate movable on said guide rods and provided with a fluid well on its under face, diaphragms closing the outer sides of said fluid wells, means on said rods for moving the upper plate toward the base plate and thereby exerting compressive force on said specimen between the diaphragms, pump means to increase the fluid pressure behind one of said diaphragms, and gauge means connected with the fluid well behind the opposed diaphragms to indicate through variations in fluid pressure the compression force applied to the specimen.

16. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper side thereof, guide rods projecting upwardly from said base plate around the fluid well and having their upper ends externally screw threaded, an upper plate having a fluid well in its lower side and provided with openings through which said upright guide rods have sliding fit, diaphragms mounted over and closing the open sides of said fluid wells, screw means on the threaded ends of said guide rods for urging said movable plate toward said base plate and exerting compression force through said diaphragms upon a specimen interposed therebetween, and means to measure through the increase of fluid pressure in one of said fluid wells the compression force applied to the specimen.

17. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper side thereof, guide rods projecting upwardly from said base plate around the fluid well and having their upper ends externally screw threaded, an upper plate having a fluid well in its lower side and provided with openings through which said upright guide rods have sliding fit, diaphragms mounted over and closing the open sides of said fluid wells, screw means on the threaded ends of said guide rods for urging said movable plate toward said base plate and exerting compression force through said diaphragms upon a specimen interposed therebetween, a fluid pump for increasing fluid pressure in the well of the base plate and exerting force behind the diaphragm thereof, and gauge means connected with the well of the upper plate indicating through resultant variations in the fluid pressure of the well the compression force applied to the specimen.

18. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper face thereof, guide rods rising from said base plate around

the well, an upper plate movable on said guide rods and provided with a fluid well on its under face, diaphragms closing the outer sides of said fluid wells and of greater dimensions than corresponding dimensions of the compression portions of the specimen, means on said rods for moving the upper plate toward the base plate and thereby exerting compressive force on said specimen between the diaphragms, pump means to increase the fluid pressure behind one of said diaphragms, bearing plates disposed on fluid floating engagement on the outer sides of said diaphragms and between said diaphragms and the specimen, means for increasing the fluid pressure behind one of said diaphragms to exert compressive forces on said specimen through the bearing plates, and means connected with one of said fluid wells indicating through variations in the fluid pressure the compressive force applied to the specimen.

19. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a supporting structure, means carried by said supporting structure to apply pressure through the opposed compression portions of the specimen, cup means at the compression portions of the specimen having therein a shifting media comprising plurality of substantially non-compressible bodies such as a plurality of loose pellets to shiftably conform to and accommodate irregularities in the compression portions of the specimen, and means to indicate compression force applied to the specimen.

20. A compression testing machine adapted for testing a columnar-like specimen having opposed compression portions comprising a base plate having a fluid well in the upper side thereof, guide rods extending in upright relation from said base plate around the fluid well thereof and having their upper ends externally screw threaded, an upper plate provided with openings slidably receiving the screw threaded ends of the guide rods and said plate having a fluid well in the middle portion thereof opening in relation opposed to the fluid well of the base member, diaphragms mounted over the open sides of said fluid wells, a pressure plate on the upper side of the diaphragm covering the lower fluid well, a pressure plate bearing against the lower face of the diaphragm covering the fluid well of the upper plate and of less transverse dimensions than the fluid well whereby said pressure plate is given a floating mounting, threaded clamping nuts turned onto the upper threaded ends of said guide rods above the upper plate, means for simultaneously turning said clamping nuts to engage a test specimen between the upper and lower compression plates, a fluid pump for increasing the fluid pressure in the fluid well of the base plate and behind the diaphragm thereof, and a fluid gauge connected with the fluid well of the upper plate.

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