Nov. 2, 1954 G. G. GOULD ET AL 2,693,109

APPARATUS FOR ADJUSTING CENTRIFUGALLY RESPONSIVE CLUTCHES

Filed June 30, 1950 2 Sheets-Sheet 1

FIG. 1.

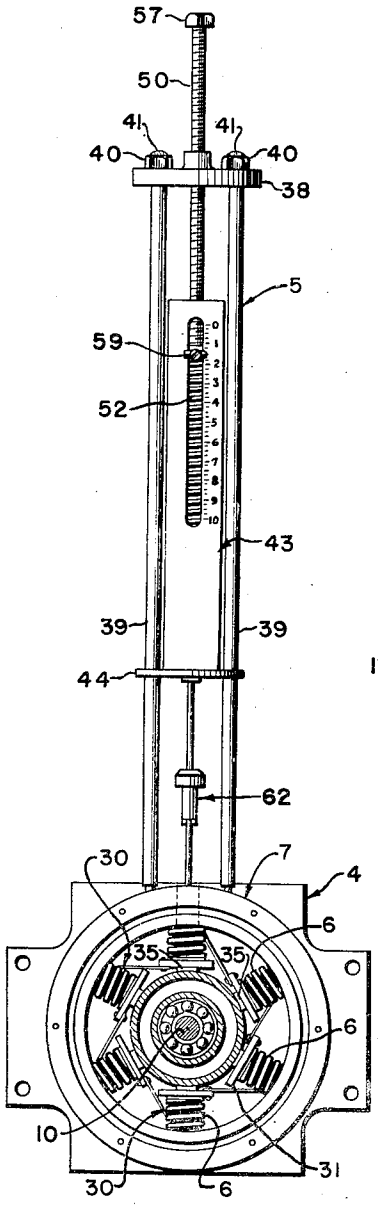
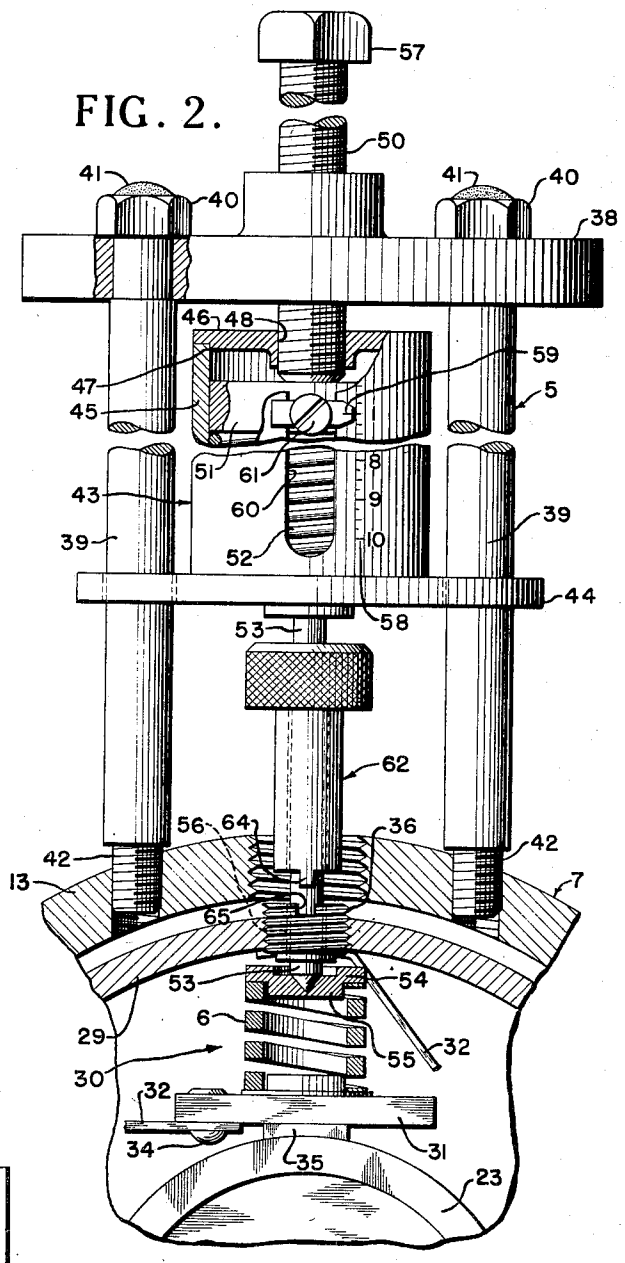


FIG. 2.



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2 Sheets-Sheet 2

FIG. 4.

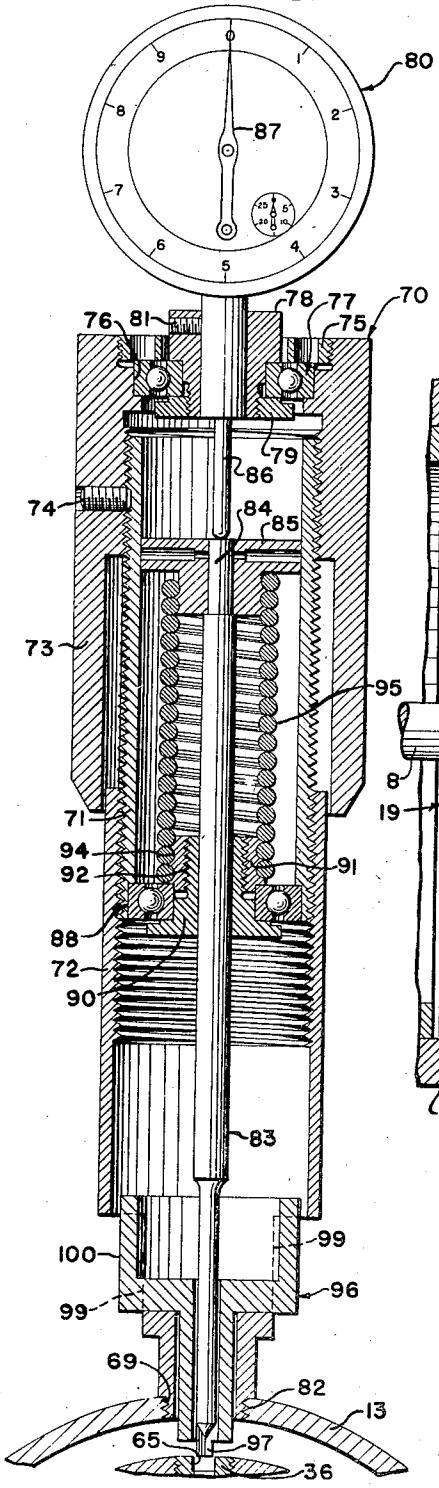
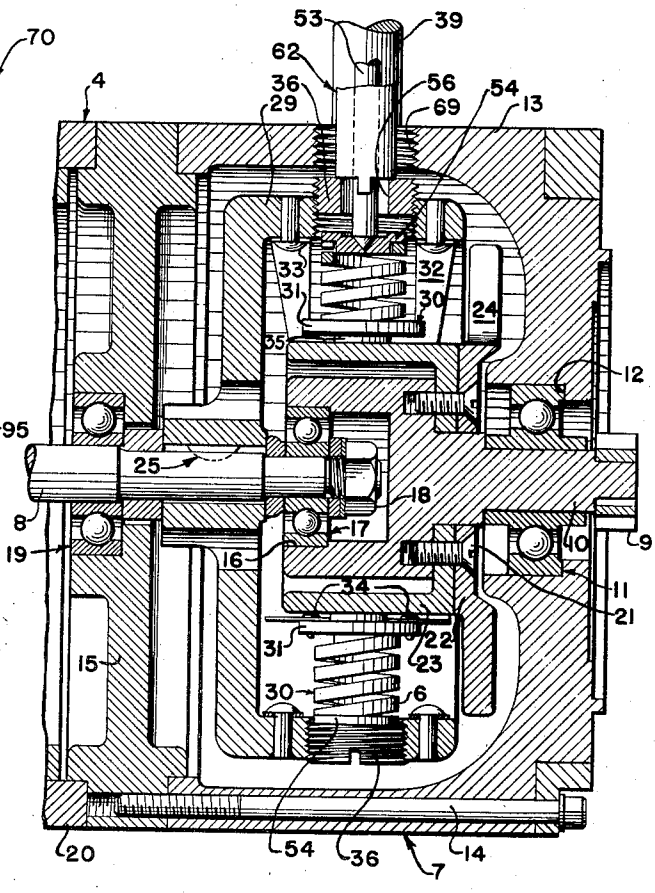


FIG. 3.



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APPARATUS FOR ADJUSTING CENTRIFUGALLY RESPONSIVE CLUTCHES

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7 Claims. (Cl. 73—161)

(Granted under Title 35, U. S. Code (1952), sec. 266)

This invention relates generally to torque converters and more particularly to centrifugally responsive constant speed clutches and a new and improved apparatus for uniformly setting the spring bias of the inertia responsive brushes thereof.

The problem of converting a variable speed drive into a constant speed output for the purpose of driving a transducer or the like has received considerable attention particularly in the fields of aviation and ordnance.

An example of one such problem is that of applying energy obtainable from a variable speed torpedo shaft to drive an A. C. generator whereby under a constant electrical load the frequency output of the generator will remain constant within one per cent while the propeller shaft speed may vary as much as 50%.

Various forms of mechanical, electrical and hydraulic apparatus have been applied heretofore in an effort to solve this problem and including many arrangements of levers and gears, complete and highly complex servo systems as well as various forms of overrunning clutches all of which fail completely to maintain the accuracy in torque conversion required. The clutch of the present invention was found to be satisfactory for this purpose.

Centrifugally responsive clutches as herein set forth, are of the type wherein a driving shaft is maintained in driving relation with a driven shaft through frictional engagement with the former by a plurality of inertia responsive brushes, spring biased into contact with the driving shaft from a fixed connection with the driven shaft. These brushes are so arranged that as the speed of the driven shaft exceeds a preselected value the centrifugal effect upon the brushes causes a lessening in frictional pressure thereof against the driving shaft with the result that a slipping of the brushes upon the driving shaft occurs at a speed selected for the operation of the driven shaft.

The degree of wear of the brushes by reason of their rubbing contact upon the driving shaft of the clutch during this interval of slip will, over a normally prolonged period of operation of the clutch, result in a proportional lengthening of the brush biasing springs and consequently a lessening in pressure of the spring force thereof against the brushes. The resultant lessening in pressure of the brushes against the driving shaft of the clutch reduces proportionally the speed at which the slippage of the brushes occurs and consequently a reduction in the secondary or output speed of the clutch.

It may be readily understood that by loading any one or a number of the brushes of the clutch over any other brush thereof the heavier loaded brushes are compelled to carry most of the torque load of the clutch during the interval of slip with the result that a more rapid wear of the loaded brushes will occur to greatly reduce the accurate life of the clutch.

Since the accuracy of clutches of this type depends so largely upon the uniformity of the loading of the inertia responsive brushes thereof it is an object of the present invention to provide for a new and improved apparatus for accurately adjusting the springs of the clutch whereby under a known centrifugal force the brushes uniformly and simultaneously disengage themselves of their locking connection between the driving and driven shafts of the clutch with the result that the relative slipping therebetween occurs at the speed selected for the driven shaft whereby this shaft is caused to maintain in this manner the speed selected therefor over a

wide range of advanced speeds of rotation of the driving shaft.

It is another object of the present invention to provide an apparatus for adjusting and securing in an adjusted position the springs of a centrifugally responsive constant speed clutch.

A further object is to provide an apparatus for applying a selected load to the springs of the centrifugally responsive clutch and securing the springs in the position of loaded adjustment.

A still further object is to provide a new and improved gage for uniformly setting the springs of a constant speed centrifugally responsive clutch and including means for securing the springs in the set position.

Other objects and many of the attendant advantages of this invention may be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a view partly in section and partly cut away of the gage of the present invention as mounted for adjusting the springs of a centrifugally responsive clutch;

Fig. 2 is an enlarged view of the gage of the present invention as mounted for adjusting the springs of a centrifugally responsive clutch and showing the spring of the clutch in an adjusted position, a fragmentary sectional portion of the clutch and certain portions of the gage being shown in section;

Fig. 3 is a longitudinal cross sectional view of a centrifugally responsive constant speed clutch having the gage of the present invention attached thereto; and

Fig. 4 is a longitudinal cross sectional view partly in elevation of an alternative arrangement of a gage for adjusting the springs of a centrifugally responsive constant speed clutch.

Referring now to the drawings and more particularly to Fig. 1 thereof, the gage of the present invention is generally designated **5** and is shown mounted for adjusting the springs **6** of a centrifugally responsive constant speed clutch generally designated **7**. As may best be seen in Fig. 3, clutch **7** connects the driven shaft **8** of an A. C. generator **4** with a suitable prime mover as, for example, the propeller shaft of a torpedo, also not shown, and adapted through any suitable medium for connecting with the gear **9** provided on the extending end of the driving shaft **10** of the clutch.

The driving shaft **10** is so arranged as to journal within a ball bearing assembly generally designated **11** and preferably press fit within a recess **12** formed in the inner face of a substantially cup-shaped housing **13** secured as by bolts **14** to the forward plate **15** of the A. C. generator **4**. The end of the shaft **10** opposite the gear **9** is so enlarged and recessed at **16** as to receive therein a second ball bearing assembly **17** and of which the inner race thereof is secured as by a nut **18** to the end of the generator shaft **8** supported as by a similar ball bearing assembly **19** conventionally arranged and secured within the forward plate **15** of the generator housing **20**. The driving shaft **10** by the arrangement set forth is thereby supported for rotation within the clutch housing **13** and over the end of the generator or driven shaft **8**.

Secured as by screws **21** to a flange formed by the enlargement of the end of the shaft **10** is a fan and friction drum **22** and **23** respectively, the fan having thereon an arrangement of extending blades **24** adapted for circulating air throughout the interior of the clutch during its operation and thereby to effect in this manner the cooling thereof.

Keyed as at **25** to the generator shaft **8** is a cup-shaped drum **29**, the cylindrical portion thereof being so arranged as to extend over the friction drum **23** in spaced relation therewith and operatively connected thereto through a plurality of spring actuated brush assemblies generally designated **30** and forming the inertia responsive elements of the clutch.

The brush assemblies **30** include brush holders **31** and are retained in proper relation within the drum **9** by a connection comprising flexible brackets **32** through which rivets **33** extend for securing the brackets and brush holders **31**, attached thereto as by rivets **34**, to the inner

surface of the drum 29, Fig. 3. The brackets 32 provide means for conveying the torque from the brushes 35, suitably retained within the holders 31, to the outer drum 29 during the operation of the clutch as will become more apparent as the description proceeds.

Springs 6 interposed, as illustrated, between the outer face of the brush holder 31 and set screws 36 therefor yieldably maintain the brushes 35 in bearing contact with the outer face of the friction drum 23 whereby rotary movement of the drum is applied through the brush assemblies 30 for driving in this manner the drum 29 and generator shaft 8 keyed therewith as heretofore indicated.

So long as no slippage occurs between the brushes 35 and the outer face of the friction drum 23 the driven shaft 8 is caused to rotate at a speed corresponding to that of the driving shaft 10. If, however, the speed of the shaft 10 increases to a value exceeding that prescribed for the shaft 8, the springs 6, by being preset to yield before a predetermined centrifugal force acting on the mass comprising the brush holder 31, are compressed to lessen the pressure of the brushes 35 against the surface of the drum 23 thereby to effect a slipping of the brushes on the drum proportional to the increase in the speed of the driving shaft 10 resulting in a relatively constant speed output from the driven shaft 8 of the clutch regardless of the increase in speed of the driving shaft 10 thereof.

The gage 5, adapted for setting uniformly the springs 6 of the clutch to the accuracy required for the purpose herein set forth, includes an upper plate portion 38 wherein is arranged for free rotation therein a pair of depending rod members 39. Nuts 40 secured as by welding at 41 to the upper end of these rods provide means whereby a wrench, or like tool, may be applied thereto for rotation of the rods, at their threaded lower portions 42, into correspondingly threaded openings provided therefor in the clutch housing 13 as illustrated in Fig. 2.

Adapted for sliding movement over these rods 39 is a spring housing generally designated 43 including a lower plate portion 44 wherein apertures are provided for movement therethrough of the rods as the housing moves vertically therebetween.

Vertically arranged on and secured to as by brazing to the upper surface of the plate 44 is a cylinder 45 of which the upper end thereof is shown closed as by an annular plate 46 having thereon a depending flange portion 47 for being received into the upper end of the cylinder and suitably secured thereto as by soldering, brazing or the like. An opening or guide surface 48 provided centrally within the plate 46 is of sufficiently large diameter to allow free movement into the housing of the lower end of an adjustment screw 50 connected as by threading within a centrally arranged aperture provided therefor within the plate 38.

Arranged for sliding movement within the housing is a partition 51 and against which the lower end of the set screw 50 bears for urging the partition in a downwardly direction through the housing whereby pressure is applied in this manner to the upper surface of a helical spring 52 arranged in the housing 43 and adapted at its lower end for bearing upon the plate 44.

Fixed to and extending downwardly from plate 44 is a rod 53 so formed at its lower end as to be received into a cone shaped recess provided therefor in the upper surface of a spring plate 54 interposed between the spring 6 of the clutch and the retaining set screw 36 therefor. The plate 54 is provided with a lower extension 55 to be received into the spring and whereby there is provided a guide for maintaining the spring in proper relation on the plate during the adjustment and operation of the clutch. The set screw 36 is equipped with a central opening 56 through which the rod 53 is passed to the surface of the plate 54 whereby an adjustment of the spring may be effected without requiring a removal of the set screw from its threaded connection with the drum 29.

As the adjustment screw 50 is rotated downwardly through the plate 38 by a wrench, or like tool, being applied to the hexagon head portion 57 thereof, the partition 51, being movable before the screw, is effective to compress the spring 52 against the lower plate 44 of the housing whereby the housing is shifted in this manner along the rods 39 to apply to the clutch spring 6, by way of the rod 53, a compression force corresponding to that applied to the spring 52. The degree of compression of the spring in pounds and fractions thereof is indicated by a calibrated scale 58 inscribed on the cylindrical face of the housing as indicated and across which a pointer 59 moves from a connection with the partion 51 through a slot 60 provided therefor in the forward section of the housing 43. The pointer 59 is secured in any suitable manner to the partition as by the screw 61.

The operation of securing the springs 6 of the clutch in an adjusted position is accomplished by means of a tool generally designated 62 rotatable over the rod 53 and having provided across the lower end thereof extending lug portions 64 adapted for connecting with notches 65 formed therefor in the outer face of the set screw 36 and whereby the screw may be rotated by the tool toward or away from the face of the spring plate 54. After proper loading the springs 6 of the clutch, in the manner set forth, the set screw 36 is rotated by the tool to the face of the spring plate 54 whereby the spring is secured in this manner in an adjusted position within the clutch.

Following the adjustment of each spring of the clutch, the set screw 50 is thereafter backed off to allow the extraction of the rod 53 from the opening in the screw 36 thereby permitting free rotation of the drum 29 within the clutch housing. The gage thereafter is connected in a similar manner to the other spring assemblies of the clutch for making corresponding adjustments thereon.

An alternative arrangement of a gage generally designated 70 and adapted for uniformly setting the springs of a centrifugally responsive clutch is shown in Fig. 4 to include a pair of threaded telescoping body sections 71 and 72 of which the former thereof is rotated within a threaded portion of the latter by means of an outer sleeve or collar 73 which preferably is knurled, not shown, the collar being threaded with the upper end portion of the sleeve 71 and secured thereto as by a set screw 74. The lower sleeve 72 is also preferably knurled, not shown, along the outer surface thereof whereby this section of the body is held while the body section 71 is rotated therein during the operation of making adjustments in the gage as will become more fully apparent as the description proceeds.

Secured as by a threaded ring 75 within a recess 76 formed in the upper portion of the collar 73 is a ball bearing assembly generally designated 77 and wherein is mounted a collar 78 which is clamped to the inner race of the bearing as by a nut 79 threaded over the lower end of the collar.

A dial indicator 80 mounted for rotation with the collar 78 in the bearing 77, is secured for vertical adjustment within the collar as by a set screw 81. The arrangement of the indicator in this manner for free rotation with the collar 78 permits the face of the dial to be easily maintained in full view of the operator at all times during the adjustment and operation of the gage.

The lower end of the sleeve 72 is equipped at 82 for threading into an opening 69, Fig. 3, provided in the clutch housing 13 and in which a closing plug, not shown, is normally received after the springs of the clutch have been properly adjusted.

Movable centrally within the gage 70 is a rod member 83, the upper end of which is adapted as at 84 for being press fit within a guide plate 85 formed for sliding movement within the sleeve 71. The upper surface of the rod is arranged in this manner to bear upon the lower end of a plunger 86 of the dial indicator whereby the degree of upward movement of the rod against the plunger is indicated in thousandths of an inch and fractions thereof upon the face of the dial by the pointer 87 thereof.

Mounted in an obvious manner within the lower end of the sleeve 71 is a ball bearing assembly generally designated 88 and wherein is secured for rotary movement with the inner race thereof a sleeve 90 clamped to the race as by a nut 91 threaded therewith as at 92. Formed about the outer surface of the nut 91 is a threaded surface 94 adapted to threadedly receive thereover the lower end of a closed spring element 95 secured in a similar manner to the under surface of the guide plate 85. The sleeve 90 provides a guide and bearing surface for the rod 83, the rod being extended outwardly from the lower end of the sleeve 72 by rotation of the upper sleeve 71

by the collar 73 into the lower sleeve as heretofore indicated.

Rotatable within the lower sleeve 72 and over the rod 83 is a tubular member, or tool, generally designated 96 and having thereon lug portions 97 projecting downwardly therefrom and corresponding to those of the member 62 of the heretofore described gage 5. These lugs 97 are adapted for connecting with notches 65 in the set screws 36 whereby the screws may be rotated by the tool into or out of spring securing position with the spring plate 54, Fig. 3, during the operation of adjusting the springs of the clutch.

Cutaway sections 99 are provided in opposite sides of the sleeve 72 and through which a knurled enlarged portion of the tool member 100 projects, the knurl not being shown, whereby access may be had to this knurled portion of the tool for rotation thereof during the operation of tightening or loosening the set screws 36.

The operation of setting the springs of the clutch with the gage as shown in Fig. 4 is accomplished by first inserting the threaded end portion 82 thereof within the threaded opening 69 provided therefor in the clutch housing 13 and thereafter while the lower part or sleeve 72 is held against further rotation, the upper sleeve 71 is rotated downwardly therein to cause movement in this manner of the rod 83 outwardly from the lower end of the tool and against the spring plate 54, Fig. 3. The application of pressure against this spring plate is conveyed to the plate 85 and thus extends the closed spring 95. Since the pressure applied to the clutch spring 6 corresponds exactly to that effecting the extension of the spring 95, the calibrated rate of extension of the latter readable upon the dial indicator 80 provides an accurate means of determining the exact force at all times being applied to the spring 6 of the clutch during the adjustment thereof.

After loading a spring of the clutch to the value required, the spring is thereafter secured in this adjusted position by rotation of the set screw 36, by the tool 96, into engagement with the upper surface of the spring plate 54, as heretofore indicated, and the sleeve 71 of the gage is thereafter rotated partially out of the sleeve 72 to retract the rod 83 from the set screw 36 whereupon the clutch may be rotated for making corresponding successive adjustments on the other springs thereof.

Obviously many other modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalty thereon or therefor.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A gage of the character disclosed for uniformly setting the spring means of a clutch having axially bored set screws for adjusting the compression of said spring means and wherein said spring means are mounted within a housing and adapted to be aligned with an opening in said housing and comprising, in combination, means including a movable rod for individually compressing said spring means of the clutch, force measuring means having a calibrated scale and a pointer operatively connected to said rod and movable thereby across said scale during adjustment of the compression of said spring means for indicating the force of compression thereof, each of said set screws being adapted to receive said rod therethrough for compressing the spring individual thereto, and a tool slideable on said plunger into engagement with said set screws and rotatable on the rod for rotating the set screws to secure the springs in said adjusted position.

2. A gage of the character described for setting uniformly the springs of a clutch having axially bored set screws for securing the springs in adjusted compression and comprising, in combination, movable means engageable with said springs through the bores of said set screws for individually compressing the springs of said clutch, calibrated means for indicating the force applied by said movable means thereby to indicate the force of compression of said springs, and means engageable with said set screws carried by said movable means for adjusting said set screws sufficient to secure said springs while the springs are compressed.

3. A gage of the character disclosed for adjusting uniformly the load applied to the springs of a clutch having axially bored set screws individual to the springs for securing the springs in an adjusted compression and wherein said springs are mounted within a housing and are adapted to be aligned with an opening in said housing and comprising, in combination, a calibrated loading spring, a rod interposed between said loading spring and a clutch spring to be loaded, means for actuating said loading spring to apply by said rod through the bores of said set screws a predetermined load to said clutch spring, and means rotatable about said rod for engaging and adjusting said set screws whereby said clutch spring may be secured in said adjusted compression.

4. A gage of the character disclosed for adjusting the springs of a clutch having axially bored set screws for securing the springs in an adjusted compression and wherein said set screws and springs are mounted in a drum and alignable with an access hole in said drum comprising, in combination, a pair of guide members adapted for fixed connection with said drum, a housing slideably movable over said guide members, a spring arranged in said housing, a partition slideably arranged in said housing and movable therein to compress said spring toward the inner end of said housing adjacent said clutch, a plate connecting said guide members above said housing, an adjustment screw threadedly arranged in said plate and movable by rotation therein through an opening provided therefor in said housing to engage and urge said partition against said spring and thereby compress the spring against said housing, a rod fixedly connected to said housing and movable through said access hole and said set screws into compressional relation with respect to each of the springs of said clutch to be adjusted, a calibrated scale, a pointer movable with said partition across said scale to indicate the pressure applied by said rod to said each of the springs of said clutch, said set screws being sleeved about and rotatable on said rod, and a tool rotatably and slideably carried by said rod for engaging the set screws through the access hole and rotating said set screws to said adjusted compression for securing the clutch springs.

5. A gage of the character disclosed for uniformly loading and setting a plurality of springs on a clutch through an access opening in the housing therefor and individual adjusting axially bored set screws respectively associated with each spring comprising a rigid mounting structure having means for attachment in the access opening of said housing, an adjustable member mounted on said structure and adapted to be moved relative thereto, a plate slidably arranged in said member and having a rod mounted for axial movement therewith and adapted to pass through said axially bored set screws to engage and apply force to any one of said springs, a resilient element operably connected between said member and said plate for applying force to said rod, means for indicating the deflection of said element corresponding to said force and responsive to relative movement between said member and said structure, and a tool slidably and rotatably mounted on said rod for setting said set screws while said force is applied to said spring.

6. A gage of the character disclosed for uniformly loading and setting through an access hole in a housing provided therefor, a plurality of clutch springs having individual adjusting axially bored set screws associated therewith comprising a pair of threaded telescoping body sections, the first of said body sections being secured to said access hole and the second of said sections being movable with respect to said first section, a rod and guide plate positioned for axial movement within said second section, said rod being adapted to engage said springs through said set screws, a resilient element operably connected between said plate and said first section, means for indicating relative motion between the body sections secured to said first section and having a plunger adapted to engage said plate, and a tool slidably and rotatably mounted on said rod for rotating said set screws to adjust the compression of the springs.

7. A gage of the character disclosed for uniformly loading and setting a plurality of springs on a clutch

mounted within a housing provided with a threaded access hole and individual adjusting axially bored set screws respectively associated with each spring and alignable with said access hole comprising a pair of threaded telescoping body sections, a rod and guide plate positioned for axial movement within one of said sections, said rod being secured at one end to said plate and having its other end extending outwardly from the other of said sections through said access hole and said set screws to engage and compress said spring, a resilient element operably connected between said plate and said one of said sections, a dial indicator secured to said one section and having a plunger adapted to engage said plate, means for threadedly attaching the other of said sections in the access hole of said housing, and a tool slidably and rotatably mounted on said rod for rotating said set screws into a setting to hold the springs in adjusted positions.

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