March 3, 1931. H. M. ROCKWELL 1,794,797

APPARATUS FOR SIZING PISTONS

Filed April 21, 1928

FIG. 1.

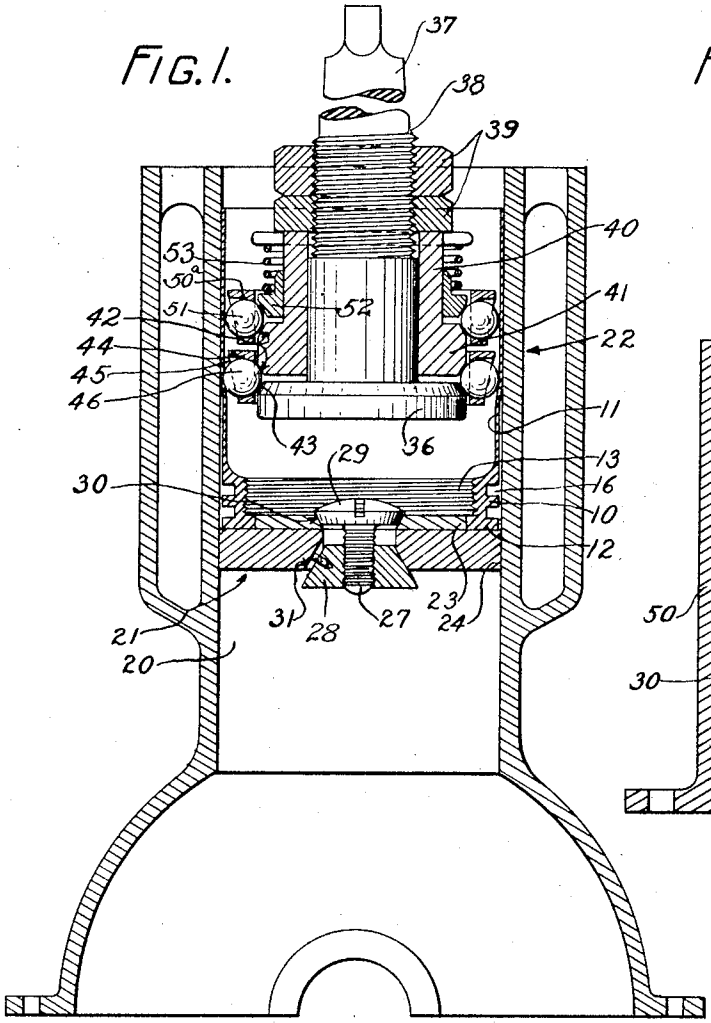


FIG. 2.

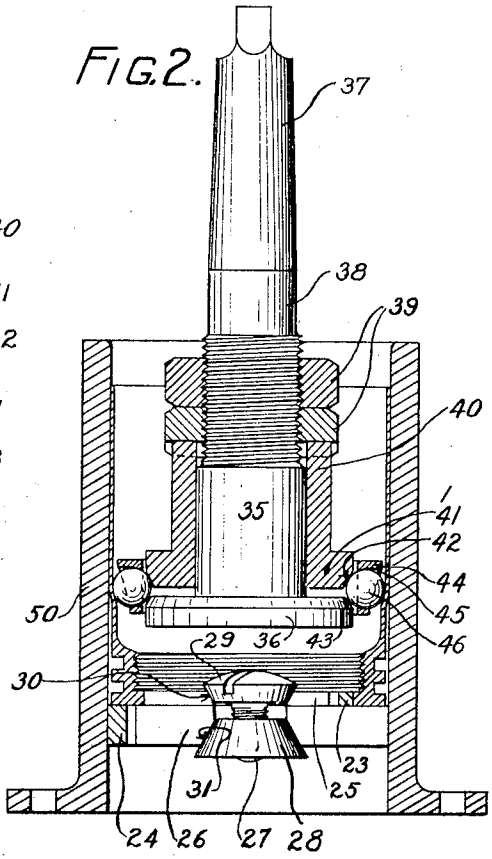


FIG. 3.

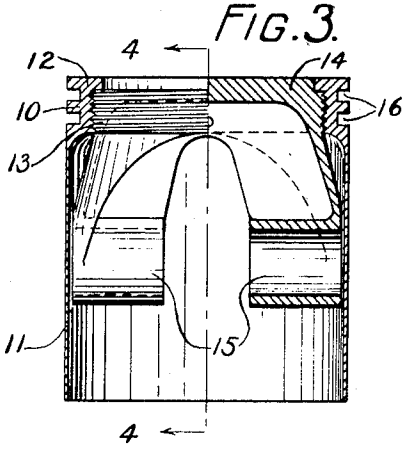
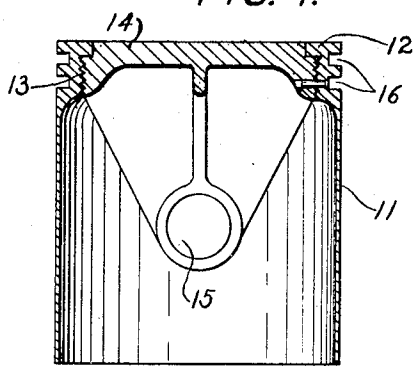


FIG. 4.



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Patented Mar. 3, 1931

1,794,797

UNITED STATES PATENT OFFICE

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APPARATUS FOR SIZING PISTONS

Application filed April 21, 1928. Serial No. 271,726.

This invention relates to the art of fitting pistons to engine cylinders, and has particular reference to a novel apparatus for accurately sizing the pistons individually.

In order that internal combustion engines and similar power units may operate efficiently and quietly it is necessary, among other things, to have the pistons well fitted within the cylinders, and for this reason the cylinder bores and piston diameters have had to be very accurately machined and held to close tolerances. The problem is even more aggravated in repair work where, because of scoring or excessive wear, the cylinders have to be rebored and fitted with over-size pistons. As the amount of material bored out under such circumstances may vary according to the degree of wear, it is necessary to carry in stock a series of different sized pistons, which vary from each other only a few thousandths of an inch. The preesnt invention overcomes these difficulties, and has, as one of its objects, to provide a novel and simplified apparatus for accurately sizing and fitting pistons as desired.

Another object of the invention is to provide such an apparatus by the use of which the piston may be initially formed to the minimum cylinder size and subsequently expanded to the larger required diameter.

A further object is to provide such an apparatus which is equally adaptable for engine manufacturing or assembling plants and for repair shops.

Another object is to provide such an apparatus which will be extremely simple, economical, and a substantial advance in the art.

These and other objects, features, and advantages of the invention will be more readily appreciated from the following description in connection with the accompanying drawings, wherein one form of the invention has been shown by way of illustration, and wherein

Figure 1 is a vertical longitudinal sectional view through a conventional engine cylinder being fitted with a piston in accordance with the invention;

Fig. 2 is a similar view illustrating another embodiment of the invention, wherein a standard sizing cylinder is employed for successively sizing a plurality of pistons;

Fig. 3 is a vertical longitudinal sectional view through one form of piston for the fitting of which the improved apparatus is particularly well adapted; and

Fig. 4 is a sectional view on line 4—4 of Fig. 3.

While the invention is adapted for the manufacture and fitting of various types of pistons, it is particularly suitable for thin steel shell pistons which, because of their lightness in weight, are adapted for use in airplane, automobile, and other high speed engines and the like. The thin skirt makes a quiet piston getting away from piston slap and will not become seized as easily as a ridged piston. I have devised several such pistons, one form of which is shown in Figs. 3 and 4 as comprising a cylindrical body portion 10 of steel or other malleable metal, having at one end, a continuous thin-walled skirt 11, and at its other end an inwardly disposed annular flange 12. Below said flange 12, the interior of the body portion 10 is counterbored and screw-threaded, as at 13, for the securement of an aluminum head 14 which closes the head end of the piston body 10 and provides wrist pin bosses 15 within the skirt 11. The exterior of the piston body 10 is provided with a plurality of circumferential grooves 16 for the reception of expansion rings of any ordinary or preferred type. In a piston of this type, the piston skirt will have substantially the same coefficient of expansion as the engine cylinder within which it operates, and thus will not be adversely affected by temperature changes, and in view of the thinness of the skirt portion it will yield readily to conform to the interior of the cylinder, the bore of which may become slightly distorted under the action of heat.

Another form of piston of this general character is disclosed in my Letters Patent No. 1,750,127, issued March 11th, 1930, which differs from the above described form in that the screw threaded connection between the aluminum head and the cast iron body, is at the extremity of the body and in the inner periphery of the annular flange 12. By hav-

ing the threaded connection inwardly of the flange 12 and shouldering against the same, the complete piston has a smoother head surface than in the other form, and is free from any rough feather edge where the thread runs out.

In accordance with the present invention, the piston bodies with their skirts are initially formed, preferably by turning in a lathe or the like or by drawing in a press, with an external diameter less than that of the larger cylinder bores. A cylinder 20 of a conventional internal combustion engine is shown in Fig. 1, and before fitting the piston therein, the interior of the cylinder is bored or ground accurately to size. The body portion 10 and its skirt 11 are then centrally disposed within the cylinder bore and clamped against rotary or longitudinal movement by a suitable clamping device 21, after which the piston skirt is expanded against the wall of cylinder 20 by rolling pressure of an expanding tool 22. The expanding tool 22 is rotatable and is longitudinally movable as it rotates, with the result that it spins the piston skirt, burnishing its inner surface and beneficially compacting the molecular structure of the material. Thus each piston can be conveniently fitted to the particular cylinder in which it is to operate, and in the case of repair work, after a cylinder has been rebored, the same piston can be expanded and used again instead of scrapping the old piston and purchasing a new one.

The specific clamping device 21 shown in the drawings comprises a pair of superimposed discs or plates 23 and 24 of different diameters, the disc 23 being adapted to engage the inner periphery of the flange 12, and the disc 24 to engage the interior of the cylinder 20. These discs are respectively provided with radial slits 25 and 26 whereby to be capable of lateral expansion by a centrally disposed screw 27 and nut 28 as they are drawn together. The screw 27 has a tapered head 29 seating in a tapered aperture 30 in the disc 23, and the nut 28 is also tapered to snugly fit in a counter sunk aperture 31 in the disc 24. From this it will be seen that the screw 27 and nut 28 not only hold the two discs together, but they expand the discs to frictionally bind the piston flange and the cylinder wall respectively.

After the piston body has thus been clamped within the cylinder 20, the expanding tool 22 is brought into play, as shown, expansively rolling the skirt of the piston against the wall of the cylinder. The expanding tool 22 preferably comprises an arbor 35 having at one end a circular flange or head 36, and at its other end a tapered key shank 37 by means of which it may be operatively connected in or to a rotary chuck or the like. Intermediate its ends, the arbor 35 is provided with screw threads 38 by means of which lock nuts 39 may be employed to hold a sleeve 40 on the arbor. The inner end of said sleeve 40 is provided with an annular flange 41 adjacent the head 36 and of substantially the same diameter, and the adjacent portions of said flange and head are beveled as indicated at 42 and 43 to define between them an angular or substantially V shaped groove. A circular cage 44 having spaced radial holes 45, encircles said groove and acts as a retainer for an annular series of steel balls 46 or other rolling pressure members. These balls 46 protrude slightly from the periphery of the cage 44 and, in operation, bear directly against the interior of the piston skirt 11 to roll it against the wall of cylinder 20.

When the expanding tool has reached the inner end of the piston skirt 11 it may be withdrawn, and the sizing operation may be finished in one or more strokes of the expanding tool. Then by loosening the screws 27 and nut 28 the discs 23 and 24 will be free to contract, permitting removal of the piston from the cylinder. The aluminum head 14 may then be pinned to the connecting rod, after which the piston body and skirt are screwed to said aluminum head, ready for assembling in operating position in the cylinder.

For some purposes such as in quantity production, it may not be either necessary or desirable to fit the pistons individually to the cylinders in which they are to operate, and therefore they may be expanded in a special sizing cylinder 50, as shown in Fig. 2. The interior of the cylinder 50 is accurately bored and ground to a definite standard diameter, and preferably the complete apparatus includes a plurality of such cylinders of different diameters for selective use as desired.

In some instances it may be desirable to expand the pistons in several successive stages using cylinders of different diameters for each stage, and particularly if the piston skirt is annealed, it can be fitted to any one of a series of cylinder sizes. The invention is extremely simple, capable of being practiced with economy, and constitutes a substantial advance in the art.

The expanding tool in its simple form, as shown in Fig. 2, is particularly suited for use with a drill press, lathe, or other form of machine tool having a positively guided spindle for driving the arbor. In some instances it may be desirable to operate the expanding tool by a portable hand drill or the like, in which case some suitable form of pilot may be employed to center and guide the arbor. One form of pilot for this purpose is shown in Fig. 1, comprising a cage or retainer 50^a surrounding the sleeve flange 41 and carrying a plurality of steel balls 51, which are normally urged outwardly by a yieldingly mounted sleeve 52 under the ac-

tion of a compression spring 53. The balls 51 follow the balls 46, but merely function to axially position the mandrel without contributing to the expansive pressure on the piston skirt 11. Instead of this arrangement, another form of pilot may be used which will rest or clamp upon the outer end of the cylinder and through which the arbor is guided in its longitudinal movement.

Obviously, the invention is susceptible of numerous modifications in the details of construction of the apparatus, and the right is herein reserved to make such changes as fall within the scope of the appended claims without departing from the spirit of the invention.

Having thus described my invention, what I claim is:—

1. In piston sizing apparatus, means for immovably holding a piston within a cylinder, a rotatable arbor concentric with the cylinder and movable longitudinally in the skirt portion of the piston while so held, and rolling pressure members carried by the inner end of the arbor, said pressure members being disposed in a single plane and adapted to engage the interior of the piston skirt to expand the same against the interior of the cylinder.

2. In piston sizing apparatus, means for immovably holding a piston within a cylinder, a rotatable arbor concentric with the cylinder and movable longitudinally in the skirt portion of the piston while so held, and an annular series of rolling pressure members carried by the inner end of the arbor, said series of pressure members being disposed in a single plane and being freely rotatable about the axis of the arbor and adapted to engage the interior of the piston skirt to expand the same against the interior of the cylinder.

3. In or for piston sizing apparatus, a rotatable arbor having an annular head portion at one end, a bushing surrounding a portion of said arbor and provided with an annular flange of substantially the same diameter as the head and adjacent thereto, said flange and head portion having their adjacent edges beveled to define between them a substantially V shaped circumferential groove, an annular series of steel balls adapted to roll in said groove, and a cage retaining said steel balls and from the periphery of which the balls protrude slightly.

4. In apparatus of the class described, means for clamping a piston within a cylinder, comprising a pair of expansible concentric discs of different diameters, one to fit within the piston and the other within the cylinder, and means for holding the two discs together, said means including tapered portions for expanding the discs.

5. In piston sizing apparatus, expansible means for clamping a thin-skirt piston within a cylinder, a rotatable arbor concentric with the cylinder, and an annular series of steel balls carried by the inner end of said arbor, said steel balls being freely rotatable about the axis of the arbor, and being adapted to exert outward radial pressure against the interior of the piston skirt whereby to expand the same to fit the cylinder.

6. Piston sizing apparatus comprising in combination, a pair of expansible concentric discs of different diameters, one to fit within a piston and the other within a cylinder, tapered means cooperating to expand said discs respectively against the piston and against the cylinder whereby to immovably clamp the piston in the cylinder, an arbor concentrically rotatable in the cylinder, said arbor having an annular head portion at one end, a bushing surrounding a portion of said arbor and provided with an annular flange of substantially the same diameter as the head and adjacent thereto, said flange and head portion having their adjacent edges beveled to define between them a substantially V shaped circumferential groove, an annular series of steel balls adapted to roll in said groove, and a cage retaining said steel balls and from the periphery of which the balls protrude slightly.

In testimony whereof, I have affixed my signature hereto.

HUGH M. ROCKWELL.