

April 14, 1959

A. E. FARR ET AL

2,881,646

STAKING TOOL

Filed Dec. 23, 1955

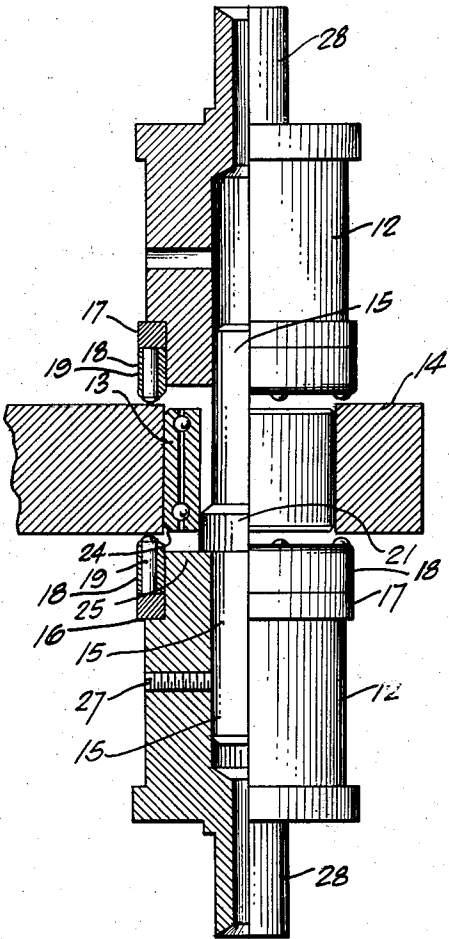


Fig. 1

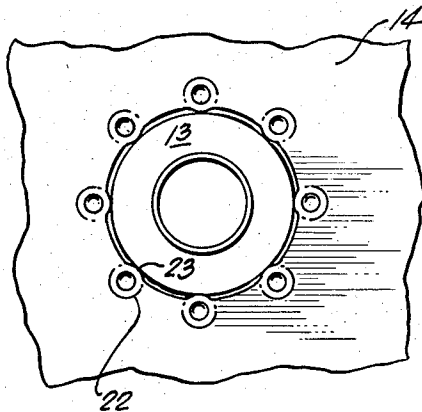
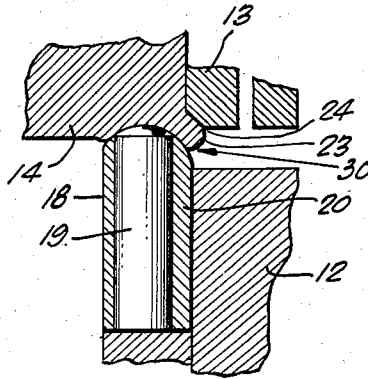


Fig. 3

INVENTORS

ALTON E. FARR
RALPH H. GRIMES AND
ALBERT F. SCHUB

B/ Edwin Coates
- ATTORNEY -

1

2,881,646

STAKING TOOL

Alton E. Farr, Ralph H. Grimes, and Albert F. Schub, Los Angeles, Calif., assignors to Douglas Aircraft Company, Inc., Santa Monica, Calif.

Application December 23, 1955, Serial No. 555,118

6 Claims. (Cl. 78—1)

This invention relates to staking tools, that is, tools for securing two or more members together coaxially by means of portions of the one member locally displaced, or peened, radially over the other member. The invention is particularly suited for staking portions of the periphery of a bearing's housing inwardly over the bearing so as to anchor the bearing in the housing, but it will become apparent that the invention is by no means restricted in its utility to this specific application thereof.

Although such general staking is well-established, the known pins are chisel-pointed and are so shaped, arranged and operational as to effect this overlap by displacing rather small masses of the metal located rather far outwardly of the inner periphery of the housing in a radially-inward direction through a noticeably relatively large distance in order to reach and overlap enough of the bearing. Their effect, thus, is to develop rather elongate, attenuated "fingers," which, although rather easily formed, are not of the optimum strength and rigidity. In fact, service breakage of these fingers, with obvious consequences, or even failure during their formation, are by no means rare, particularly when coupled, as is not uncommon with the inevitable disadvantage of the chisel-point staking peens' or pins' concentrated unit stress on the metal setting up cracks in same in radial lines emanating therefrom.

It is necessary, in such close-tolerance work, as is required in "fine-peening," to so control the depth of the peening that produces the aforesaid fingers that the peening indentation is not so deep as to "freeze" the housing and bearing together, as such would almost prevent their disassembly for repair work. On the other hand, these indentations are necessarily of a depth sufficient to provide an effective radial flow of metal over the inner one of the coaxial members. Yet, until the advent of the present invention, the depth of staking penetration was strictly dependent upon control of the pressure exerted by the hydraulic press doing the staking. Since this control depends entirely on the skill of the press-operator and must be adapted to the various materials and their state of heat treatment, it is clear that proper depth of staking heretofore has been very difficult to attain.

Not negligible is the fact that, with the currently employed chisel-point staking tools, the cost of maintenance of the tools, each incorporating a plurality of these chisel-points, is strikingly high. Needless to say, the sum total of all the aforestated imperfections is inconsistency in staking, so much so that specific push-out or design-thrust "allowables" for the staked article can seldom, if ever, be achieved.

This invention is predicated broadly upon the fact, among others, that the unit-stress in the surface of properly arranged spherical or spheroidal or rounded indentations is noteworthy less than that in chisel-pointed, V-notched or the like, acute dihedral-angled peening surfaces. Consequently, there is less danger of developing cracks in staking or of setting up unbalanced stresses in the assembly.

Another fact of which this invention takes advantage is

2

the improvement effected by, instead of moving a small mass of staking metal a long radial distance to form long attenuated hold-down fingers, moving a relatively large volume of staking metal a relatively short distance radially away from the inner periphery of the housing to overlap the coaxial bearing being staked in place.

One configuration embodying these facts provides a staking tool in two complementary halves for embracing between them, and staking together, coaxial, inner and outer bodies. Each tool-half comprises a body having a pair of circular, generally flat end faces, these end, or inner, faces of the coaxial tool-halves or tool components, confronting each other in use. Each such face includes a plurality of penetrative means arranged peripherally thereon in equidistant circumferential spacing, and each penetrative means extends axially of the body and outwardly from the face.

Preferably, the penetrative means take the form of hard metallic pins, each having its outer end ground to spheroidal form, the pins extending a fixed distance beyond the end of the face which preferably does not exceed a few hundredths of an inch. The ring of pins lies a short distance radially inwardly from the outer periphery of the face, with the pin centers lying a distance from the bore edge of the bearing housing that slightly exceeds the protruding length of the pins aforesaid. The pins being larger diametrically than the chisel-point pins for the same job, displacing a larger volume of staking metal and being located relatively closely to the bore edge of the bearing housing, consequently displace a substantively larger volume of metal through a lesser distance than heretofore was the practice. That is, the prior long, thin "fingers" are transformed into thick tongues which have a very short length. The sphericity of the indentations reduces the unit-stress and minimizes the possibility of fracture. The side-load factor is constant. The tool ceases penetrating automatically at a fixed predetermined depth.

Usually eight pins are employed on each face since this number of this novel pin gives adequate bearing-retention staking yet permits such push-out results that as many as three re-stakings and bearing replacements can be accomplished.

The tools are particularly suited for hydraulic-press staking because the body of the tool serves as a stop to control the depth of penetration of the pin, and special stop controls need not be built into the press.

Mainly in order to render the inventive concepts more concrete, the presently-preferred one of the many forms which the invention may take is illustrated representationally in the accompanying drawings and will be described hereinafter in conjunction with these drawings.

In these drawings:

Fig. 1 is a view partly in side elevation and partly in longitudinal section, of one of the tools in use on a bearing and a housing therefor, the staking dies not having come together to complete their staking stroke;

Fig. 2 is a fragmentary top plan view of a bearing staked to its housing by means of the tool of the present invention; and

Fig. 3 is a fragmentary enlarged detail of the lower left hand peen arrangement shown in Fig. 1.

The construction shown in the drawings comprises a pair of essentially similar peening dies 12, the lower one of which, preferably, is removably fixed by means of an extension or shank 28 in an anvil or other abutment. The upper die is adapted to be mounted by a similar shank 28 in an arm, ram, press-head, or the like, not shown, which is adapted to move toward the anvil so as to urge the upper die forcefully toward the lower die in order to bring the dies relatively toward each other in effecting the staking operation.

Each die is centrally hollow, longitudinally, in order to receive a pilot-pin 15 which concurrently pilots the two dies in reciprocation and, by means of a medial annular enlargement 21, also maintains the bearing to be staked properly centered and laterally positioned with respect to the dies. The support member or housing 14 for the bearing 13 is assumed to be properly self-centered with respect to the bearing and to be tightly enough seized, frictionally, to the periphery of the bearing to remain centered properly with the thus-centered bearing. The bearing and housing rest upon the anvil, or platen-supported lower die.

In order to provide spheroidal or spheric staking indentations in both faces of the housing concurrently, and at the proper predetermined depth of the order of .013 inch and edge-distance from the bore-edge of the housing, of the order of .055 inch, the peripheral margin of the inner face of each die is provided with either metal-flowing units or staking pins 19, arranged equidistantly and circumferentially of these margins.

More specifically, in order to provide these staking instrumentalities, the periphery of the inner end of each die is constricted to provide an annular groove, or seat, 16 onto which is press-fitted or "sweated" a hard ring 17 constituting a carrier or base for the pin-ring 18 which is pressed onto the die body 12 and against ring 17.

The pin-ring directly mounts the eight pins or peens 19, which consist of hard steel rods with spheric outer ends, the inner portions being embedded in the pin ring and extending coaxially thereof, but with their axes lying closer to the outer periphery of ring 18 than to the inner periphery thereof. Said inner periphery is chamfered inwardly and toward the end-face of the tool-component as at 30, as later explained and the spheric head protrudes a distance of the order of .013 inch from the ring 18.

The indentations in the metal of the housing are given an annular, protuberant rim 22, see Fig. 2, the inner semi-circular portion of which, 23, flows inwardly in the space 30 between the annular chamfer 24 on the outer edge of each face of the bearing per se and the chamfered surface 20. There is a relatively large body of unsupported metal at this edge of the bearing-housing encompassed or subtended between the pins and the bearing-edge and it is formed into a thick short semi-circular tongue 23 which has only a short radially-inward distance to be flowed in order to overlap and seize the edge of the bearing.

The staking tool, bearing, and housing are set up and centered in a ram-type hydraulic or pneumatic press with the controls carefully set so that the proper pressures will not be exceeded and all parts are aligned before ramming. If the bearing is one which is retained on one side by the shoulder of a counterbored housing or by a snap ring, only the "open" side of the assembly is to be staked. A check of the freedom of the bearing will ordinarily show no lost motion and, except under excessive axial thrusts, the short, thick tongues will rigidly maintain this condition, breakage of more than one or two tongues seldom, if ever, occurring.

"Over-staking," or excessive penetration of the staking pins and consequent thinning of the roots of the tongues, etc., is prevented by the fact that the dies act as their own stop, the maximum penetration of the pins, when the dies "bottom," being predetermined by the amount of length thereof exposed, since the curved, or chamfered, edge of the pin-retaining ring 18 then acts as a positive stop.

In order to alter the configuration shown, it is only necessary to remove the two-press-fitted rings and substitute a pin ring and base ring of different dimensions or configurations.

Although certain elements have, for sake of concreteness, been described hereinabove by means of reference to their specific shapes, compositions, etc., it is to be understood that the invention itself is not limited in

its scope to any particular embodiment but includes any construction covered by the following claims.

We claim:

1. A tool-component for use in staking together an inner member and an outer member, the two members being initially frictionally held together in coaxiality and the outer member being composed of pressurably cold-flowable and peenable material, comprising: an elongate body having opposed, first and second, end-portions, the end-face of the first end-portion including means protruding therefrom and arranged to receive axially directed reciprocation producing forces applied to said tool-component; and a plurality of staking means disposed in circumferentially spaced loci on the outer peripheral marginal-portion of the end-face of the second end portion of said body, each of said staking means having a spheric staking face protruding longitudinally from said end-face, said staking-face being of large area relative to the predetermined maximum staking-penetration of said staking means, whereby to constrain said staking means to apply to corresponding loci on the inner peripheral edge-portion of the outer one of said coaxial members, staking forces of low-intensity per unit area of staked surface, the relatively large area and marginal location of said spheric surfaces effecting displacement of the staked material radially inwardly over the inner one of said coaxial members in the form of a plurality of wide, short and thick tongues of relatively great strength; thereby to firmly and stably unite said members co-axially together.

2. A tool-component for use in staking together an inner member and an outer member, the two members being initially frictionally held together in coaxiality and the outer member being composed of pressurably cold-flowable and peenable material, comprising: an elongate body having opposed, first and second, end-portions, the end-face of the first end-portion including means arranged to receive axially directed reciprocation producing forces applied to said tool-component; and a plurality of staking means disposed in circumferentially spaced loci on the outer peripheral marginal-portion of the end-face of the second end-portion of said body, said staking means being shaped and arranged to form at the inner periphery of said outer body a plurality of tongues extending radially inwardly and over said inner member; each of said staking means extending longitudinally outwardly from said end-face a distance predeterminedly calibrated to the predetermined optimum radial extent of said tongue, said predetermined distance being that distance which enables the last-said end-face to contact the adjacent face of the outer one of said two coaxial members before said staking means have penetrated said outer coaxial member beyond a predetermined optimum depth, thereby automatically to prevent over-staking of said outer coaxial member.

3. A tool-component for use in staking together an inner member and an outer member, the two members being initially frictionally held together in coaxiality and the outer member being composed of pressurably cold-flowable and peenable material, comprising: an elongate body having opposed, first and second, end-portions, the end-face of the first end-portion including means for enabling reciprocatory motion to be applied to said body; the end-face of the second end-portion including a peen-carrying ring removably mounted onto the periphery of said second end-portion adjacent said end-face and a plurality of longitudinally protruding peens-pins disposed in circumferentially spaced relationship on the exposed end-face of said ring; the inner edge of said ring having a chamfered surface affording a passage between each of said pins and the inner one of said coaxial members, said passage receiving material displaced therein by the peening action of said pins, and material being urged substantially unimpededly through said passages and radially inwardly and stakingly over the inner one of said coaxial members as a plurality of continuous, strong

5

tongues that are substantially immune to rupture thereof during their formation.

4. A tool component for use in staking together an inner member and an outer member, the members being initially frictionally held coaxial and the outer member being composed of pressurably cold-flowable material, comprising: an elongate body having opposed, or first and second, end portions, the end face of the first end portion including attaching means for use in moving the body in the axial direction during staking; and a plurality of material-penetrative means disposed in circumferentially spaced loci on the outer marginal edge-portion of the end face of the second end-portion, each of said means having a staking face constituting a portion of the surface of a solid-of-revolution of that category which has an area which is large relative to the total volume of said solid-of-revolution, whereby to constrain said staking means to apply to corresponding loci on the inner marginal edge-portion of the outer one of said coaxial members material-displacement forces of such low unit-area intensity and as to effect formation in said inner marginal edge portion of a plurality of wide, thick, short and strong staking tongues which are radially inwardly urged therefrom.

5. A tool-component for use in staking together an inner member and an outer member, these members being initially frictionally held in coaxiality and the outer member being pressurably cold-flowable for enabling staking portions of its inner marginal portion over the inner member, comprising: a body having first and second end-portions, the second end portion including a circular end-face; the second end-portion having a peen-carrying ring removably and replaceably mounted to its periphery adjacent the end-face of said end-portion, said

6

ring carrying a plurality of peens disposed in circumferentially spaced relationship so as to protrude longitudinally from said ring, whereby to enable replacement of a ring containing impaired peens with a ring containing only undamaged pins in pristine and effective condition.

6. A tool-component for use in staking together an inner member and an outer member, the members being initially held in co-axiality by mutual frictional engagement thereof and the outer member being pressurably cold-flowable for enabling staking portions of its inner marginal portion over the inner member, comprising: a body having first and second end portions, the second end portion including a substantially circular end-face; the second end-portion including an annular member encircling same and protruding therefrom in the axial direction; a plurality of staking-members mounted in circumferentially spaced relationship on said annular member and protruding axially slightly therefrom; and a chamfer located on the inner side of the protruding portion of said annular member, said chamfer being directed inwardly and toward the end-face of said end-portion so as to afford passageway between the protruding end of each of said staking means and the adjacent portion of the inner one of said coaxial members.

References Cited in the file of this patent

UNITED STATES PATENTS

30 1,903,776	Clark et al. -----	Apr. 18, 1933
1,928,443	Archer et al. -----	Sept. 26, 1933
1,958,972	Miller -----	May 15, 1934
2,383,727	Lewis -----	Aug. 28, 1945
2,440,435	Brown -----	Apr. 27, 1948