The invention relates generally to fastening devices such as self-locking retaining rings, nuts and the like and more particularly to a device or tool for effecting removal of such locking device from an element on which it is mounted.

The invention has among its objects the production of a tool which will enable self-locking rings, nuts and the like to be quickly and easily removed from their supporting elements without destruction or damage to the element or the retaining device, whereby the latter, if desired, is reusable.

Another object is the production of such device which is exceedingly simple in construction, comprising in one of its simplest forms a single member which may be relatively inexpensively produced and which is very rugged and durable in construction.

A further object of the invention is the production of such device which may be readily designed to match any specific type of self-locking retaining device, whether of external or internal locking construction.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the description herein given.

In the drawings, wherein like reference characters indicate like or corresponding parts:

FIG. 1 is a top plan view of one form of self-locking retaining device of a type adapted to be mounted on a cylindrical rod or shaft, as illustrated;

FIG. 2 is a sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a side elevational view of a tool constructed to remove retaining rings of the type illustrated in FIG. 1;

FIG. 4 is an end elevational view of the tool illustrated in FIG. 3, taken from the end of the tool which is adapted to engage the self-locking retaining device;

FIG. 5 is a longitudinal sectional view, on an enlarged scale, similar to FIG. 2, illustrating in section the end portion of the tool in FIG. 3;

FIG. 6 is an end elevational view, similar to FIG. 1, illustrating a locking device which is adapted to be seated in a bore or the like for retaining an element such as a shaft therein;

FIG. 7 is a sectional view taken approximately on the line 7—7 of FIG. 6, the self-locking retaining device and shaft being illustrated in elevation;

FIG. 8 is a sectional view similar to FIG. 7 showing in elevation a tool adapted to remove a self-locking retaining device of the type illustrated in FIG. 6, portions of the tool being broken away to show the details thereof; and

FIG. 9 is a sectional view on an enlarged scale, similar to FIG. 5, illustrating in section, the end portion of the tool shown in FIG. 8.

The present invention contemplates the production of a tool for removing self-locking retaining devices and the like which is so designed that it may be disposed adjacent the retaining device to be removed and manipulated to engage the locking elements of such a retaining device whereby the latter is to be interlocked with the tool that force applied to the tool in a direction to remove the retaining device will be transmitted to the latter and effect such removal.

The construction of the tool is such that removal forces are applied to the retaining device at the most desirable points to effect a release of the locking forces between the retaining device and the supporting element, following which the retaining device may be readily removed therefrom.

Retaining devices of the type here involved may take many forms, depending upon the nature of the articles on which they are to be employed and the drawings therefore illustrate merely two forms, each of which embodies a generally ring-like structure provided with a plurality of radially extending projections, such projections in the case of the construction illustrated in FIGS. 1 and 2 being inwardly directed and adapted to engage a rod, shaft or the like, while the construction illustrated in FIGS. 6 and 7 employs outwardly directed projections adapted to engage the circumferential surface of a bore or the like.

It will be appreciated that while the tool is illustrated in connection with ring-shaped retaining devices, the latter may be of any specific shape and employ any suitable number of locking projections, either inwardly or outwardly directed to achieve a fastening of the elements involved, the tool, as will be apparent from the foregoing description, being readily constructed to accommodate the specific fastening device involved.

Referring to FIGS. 1 through 5, and more particularly to FIGS. 1 and 2, the reference numeral 1 indicates generally a retaining device of the self-locking type adapted to limit relative movement between a rod or shaft 2 and an element having an annular portion 3 through which the shaft 2 extends. The retaining device 1 is illustrated as being formed from flat spring stock or the like, having an annular outer portion 4 which is provided with a plurality of inwardly directed projections 5 adapted to engage the peripheral surface of the shaft 2. Such projections, as clearly illustrated in FIG. 2, are inclined upwardly with respect to the plane of the annular portion 4, as the radial distance from the inner end edge of each projection to the axis of generation of the annular portion 4 being slightly less than the radius of the shaft 2. Thus the retaining ring 1 may be applied to the shaft 2, as illustrated in FIG. 2, by placing the ring on the end of the shaft 2 and forcing the ring downward on the shaft as illustrated, the end of the latter preferably being slightly beveled as indicated at 6 to facilitate such mounting. Such operation will increase the angle of divergence of the projections from the plane of the annular portion 4, whereby the natural resiliency of the material of the ring will urge the inner ends of the projections 5 into firm engagement with the shaft. It will be apparent that due to the inclination of the projections 5 any force applied to the annular portion 4 by the member 3 tending to force the retaining ring off of the shaft 2 will tend to rock the projections 5 about their connection with the shaft 2, increasing the tendency of the projections to bite into the shaft. Such type of ring thus will offer considerable resistance to forces applied to the annular portion of the retaining device in a direction to remove the ring from the supporting element such as the shaft 2. In most cases, in the absence of a tool such as that here involved, the rings are destroyed in effecting a removal, and often, as the rings are normally fabricated from spring steel or the like and thus of harder material than that of the shaft 2, the latter may be scored or damaged in the process of removing the retaining ring.

Referring to FIG. 3, the tool comprises a body member, indicated generally by the numeral 11, illustrated as being formed from tubular cylindrical stock having a wall thickness which is less than the difference between the radius of the inner edge 7 of the annular portion 4 of the retaining device 1 and the radius of the shaft 2 on which the retaining ring is to be mounted. The outer diameter of the member 11 is somewhat less than the diameter of the inner edge 7 of the retaining ring and the inner diameter is somewhat larger than the diameter...
of the shaft 2. One end of the body member 11 may be suitably constructed for manual engagement, as for example, having a knurled portion 12 thereon, and the opposite end is constructed for interlocking engagement with the retaining ring 1. Referring to FIGS. 3 and 4, such engaging end of the member 11 is provided with a plurality of fingers 13 which are of generally triangular shape, the number of which corresponds to the number of projections 5 of the locking ring with which it is to be used, each of the fingers 13 terminating at their outer ends in transversely extending portions 14. Thus the member 11 may be readily disposed on the free end of the shaft 2, the fingers 13 disposed between the projections 5 and the adjacent end of the tool seated upon the end face of the member 3, and by rotating the tool in a clockwise direction, as viewed in FIG. 4, or counterclockwise with respect to the engaging end of the tool, as viewed in FIG. 1, the transversely extending portions 14 may be disposed between the end face 8 of the member 3 and the adjacent face of each projection 5, as will be clear from FIG. 5. The retaining ring may then be readily removed from the shaft 2 by simultaneously applying sufficient force in a circumferential direction to make the engagement of the projections 14 with the projections 5 and applying axially directed force on the tool in a direction to effect removal of the retaining ring from the shaft, namely, upwardly as viewed in FIG. 5.

The fingers 13 and transversely extending portions 14 may be readily formed on the end of the member 11 by means of a suitable cutting tool D, diagrammatically indicated in FIG. 3 in dotted lines, which for example, may be disc-shaped, having parallel faces, and adapted to be engaged with the end of the member 11 to cut a notch or channel 15 therein, one face of the disc cutting the edge 16 of one finger 13, the end edge of the disc cutting the edge 17 of an adjacent finger 13 and the opposite face of the disc cutting the inclined edge 18 of the transversely extending portion 14 of the latter finger. The cutting disc D preferably is so disposed that its axis A not only extends at an angle with respect to the axis of the member 11, as viewed in FIG. 3, but also is tilted in a plane extending vertically to the plane of the drawing. The upper portion of such axis is viewed in FIG. 3 being rotated outwardly out of the plane of the drawing and the lower portion being rotated downwardly out of the plane of the drawing. With the axis of the cutting disc being so disposed, the top edge of each transversely extending portion 14, as viewed in FIG. 3, will not only have an axial inclination or pitch from its free end but also will have a radical inclination or pitch whereby each portion 14 maintains its greatest vertical thickness as viewed in FIG. 5 adjacent its inner wall and thus adjacent the member 3.

It will be apparent that with the longitudinal or axial pitch or inclination of the transverse portion 14 from its free end edge thereof, insertions of such portions 14 into the end face 8 of the member 3 and the adjacent face of the projection 5 of the retaining device is readily and easily effected and by continued rotation of the tool in the proper direction, the inclined edge 18 of the tool will engage the free ends of the projections 5 upwardly, tending to pivot them out of engagement with the shaft 2. As will be apparent from a reference to FIG. 5, the transverse portions 14 are so formed that the radial inclination or pitch of the edge 18, which is greater than the corresponding angle of the projections 5, so that each portion 14 will initially engage the associated fingers 13 closely adjacent to the extreme free end thereof which is engaged with the shaft 2.

FIGS. 8 and 9 illustrate details of a tool similar to the tool 11 but designed for use in removing external self-locking rings, for example, of the type illustrated in FIGS. 6 and 7.

Referring to the latter figures, the reference numeral 1' indicates generally a retaining device of the self-locking type adapted to limit movement between a rod or shaft 2 and an element 3 having a bore 3' therein in which is disposed the shaft 2, the adjacent end of the latter being radially disposed with respect to the mouth of the bore 3'. The retaining device 1' is generally similar in construction to the retaining device 1 but is of a transversal locking type and is adapted to be firmly locked with the side walls of the bore 3' of the element 3 and thus form a stop for limiting axial movement of the shaft 2 relative to the element 3 in an upward direction as viewed in FIG. 7.

The retaining device 1' is illustrated as being generally similar in construction to the device 1' being formed from flat spring stock or the like, having an annular inner portion 4' which is provided with a plurality of outwardly directed projections 5' adapted to engage the peripheral surface of the bore 3', such projections, as clearly illustrated in FIGS. 7 and 8, being inclined upwardly with respect to the plane of the annular portion 4', the radial distance from the outer edge of each projection to the axis of generation of the annular portion 4' being slightly greater than the radius of the bore 3'. The retaining ring 1' may be disposed in the bore 3', as illustrated in FIG. 7, by first forcing the ring 1' into the mouth of the bore 3' and forcing the ring downward into the same, the mouth of the bore 3' preferably being slightly beveled as indicated at 6' to facilitate such insertion. As in the mounting of the ring 1, the projections 5' of the ring 1', as the latter is forced into the bore 3', will increase the angle of divergence of the projections from the plane of the annular portion 4, whereby the natural resiliency of the material of the ring will urge the outside of the projections 5 into firm engagement with the side walls of the bore 3'. Likewise, due to such inclination of the projections 5', any force applied to the annular portion 4 by the shaft 2 tending to force the retaining ring out of the bore 3' will tend to rock the projections 5' about the connection with the side wall of the bore 3', increasing the tendency of the projections to bite into the member 3 and producing that much greater resistance to outward movement of the ring 1'. In the removal of the ring 1' without a tool such as that here involved, the ring normally will be destroyed, with a possibility of scoring the side walls of the bore 3' or otherwise damaging the element 3.

The tool for removing the ring 1' is generally similar to the tool 11, comprising a body member 21 formed from tubular cylindrical-shaped stock which may be provided at its upper end, as viewed in FIG. 8, with knurling to facilitate manually grasping the same, and at its lower end is provided with a plurality of fingers 23, corresponding to the fingers 13, which ends in transversely extending portions 24, corresponding to the portions 14.

As in the construction illustrated in FIG. 3, the tubular cylindrical stock from which the member 21 is fabricated has a wall thickness preferably slightly less than the difference between the radius of the outer edge 7' of the annular portion 4' of the retaining device 1', and the radius of the bore 3' in which the retaining ring is mounted. The outer diameter of the member 21 is somewhat less than the diameter of the bore 3', and the inner diameter is somewhat larger than the diameter of the outer edge 7' of the annular portion 4', whereby the ends of the fingers 23 and transversely extending portions 24 thereof may be readily disposed between the projections 5', and as the retaining device 1' employs six such projections, the member 21 may be secured to the seized portion 4' and engaged with six fingers 23 and portions 24.

As in the construction illustrated in FIG. 3, the fingers 23 and transversely extending portions 24 may be readily formed on the end of the member 21 by means of a suitable cutting tool which likewise may be provided with parallel faces and adapted to be engaged with the end of the member 21 to cut a notch or channel 25 therein, one face of the disc cutting the edge 26 of one
fing 13, the end of the disc cutting the edge 27 of an 
adjacent finger 13, and the opposite face of the disc 
cutting the inclined edge 28 of the transversely extending 
portion 24. The cutting disc in this case would be pref-
erably so disposed that the portions 24 will also have a 
radial inclination or pitch as well as an axial inclination 
or pitch from its free end, but in this case the pitch will 
be reversed from that of the portions 14, whereby each 
portion 24 will have its greatest vertical thickness as 
viewed in FIG. 9 adjacent the wall of the bore 3' when 
the tool is applied to the ring 1'.

In the use of the fingers 24 of this construction will 
engage the ends of the portions 5' adjacent their inter-
locking connection with the element 3' with the end of 
the tool seating on the adjacent end of the shaft 2, and 
as the tool is rotated relative to the locking ring, the 
portions 4 will cam the outer ends of the portions 5' 
upwardly, tending to withdraw them from engagement 
with the side wall of the bore 3'. By applying 
force on the tool 21 tending to withdraw the same from 
the bore 3', the ring may then be drawn upwardly to 
effect removal thereof from the bore 3'. To achieve a 
greater flexing of the projections 5' and thus additionally 
reduce the forces of engagement between the ends of 
the portions 5' and the side wall of the bore 3', a 
cooperable member may be provided, which in the 
embodiment illustrated in FIGS. 8 and 9 comprises a cylin-
drical rod-shaped member 29 which may be beveled as 
indicated at 31 at its lower end and suitably rounded at its 
upper end, the diameter of the member 29 being such 
that the member may be snugly but slidably received in 
the member 21. Thus by applying downward pressure 
on the member 29, the lower end 32 of which, as illus-
trated in FIG. 9, is adapted to bear on the upper face of 
the annular portion 4' of the locking ring, and simul-
taneously applying upward forces to the member 21, con-
siderably greater flexing of the projections 5' may be 
readily achieved so that the resistance of the locking ring 
to the removal forces is considerably reduced.

To facilitate simultaneously applying downward forces 
to the member 29 and upward forces to the member 21, 
the latter may be suitably formed at its upper end with 
an outwardly extending annular-shaped bead or ridge 33, 
whereby the member 21 may be readily grasped between 
the index and forefinger and the thumb placed upon the 
upper end of the member 29. Downward forces may 
then be applied by the thumb to the member 29 and up-
ward forces may be applied by the fingers engaging the 
knurled portion 22 and the bead 33 to urge the same 
upwardly.

In some cases it may be desirable to provide a similar 
cooperable member 19 for use in the construction illus-
trated in FIG. 3, the member 19 comprises a tubular 
their member having an internal diameter that is slightly 
larger than the exterior diameter of the member 11, 
whereby the sleeve 19 is slidably carried on the 
member 11. The lower end of the sleeve member 19 may be 
provided with a counterbore 20 of a size to reduce the 
thickness of the side wall of the member 19 adjacent 
the ring 4 to such dimension that the adjacent end of the 
member 19 will seat only upon the top face of the an-
nular portion 4 of the ring and, if desired, the upper end 
of the member 19 may be provided with a suitable out-
wardly extending flat or rim to provide ample means 
for manually grasping the member, whereby downward 
pressure may be applied thereto, while upward forces 
are applied to the member 11 as previously described. 
However, in many if not most cases, the use of only the 
member 11 will enable ready removal of a locking ring 
such as the member 1.

It will be appreciated that the members 11 or 21 and 
if employed, their respective cooperable members 19 or 
29, will be formed to suitably correspond to the shape 
of the lock rings or members with which they are to be 
employed, and it will be appreciated that in some cases it 
may be possible to employ a single size of stock to fabri-
cate the members 20 and 21, as for example, where the 
inner and outer radii of the projections 5 correspond to 
the radii of the inner and outer radii of the projections 5' 
and in such case it would also be possible on the opposite 
ends of a tool with ring engageable fingers, one set being 
constructed to remove internal type rings and the other 
being constructed to remove external type rings.

It will also be appreciated that the number of ring-
engaging fingers will be varied in accordance with the 
number of locking projections employed in the lock-
ing device. Thus, for example, if the locking device 
were in the form of a metal nut or fastener wherein a pair 
of oppositely disposed projections are struck up from 
a rectangular strip of spring steel or the like, for 
engagement with either a threaded or unthreaded stem 
or rod, the removal tool would be provided with similar-
disposed fingers.

It will also be appreciated that in some cases it may 
be desirable to construct the members 11 or 21 in a plurality 
of sections, as for example, forming such members in 
the semi-circular halves which, if desired, may be suit-
ably pivoted or otherwise adjustably or detachably con-
nected. Such construction would permit the use of a tool 
embodying the invention to move a retaining ring such as 
the ring 1 longitudinally on a shaft where for one reason 
or another the end of the shaft was not accessible to permit 
the application of a tubular tool thereto. If the tool is merely 
made in two halves which may be disposed in assembled 
relation, the member 19 may be formed to act as a con-
necting member for the two halves, such construction, 
however, being limited to applications suitable for its use.

It will be noted from the above description that I have 
provided a relatively simple tool which may be readily 
designed for effecting removal of self-locking retaining 
means and other retaining devices and readily constructed 
for use with internal or externally locking rings or de-

It will also be noted that the design of the tool is such 
that it not only enables such a locking ring to be removed 
but effects such removal without damage to either the 
ring or associated structures such as shafts, bores, etc.

Having thus described my invention, it is obvious that 
while various immaterial modifications may be made in the 
same, it will be understood as limiting myself to the 
exact form, construction, arrangement and combination 

What I claim as new and desire to secure by Letters Patent is:

1. A tool for removing a self-locking retaining device 
affixed to a cylindrical surface of a supporting element, 
wherein the self-locking retaining device includes an 
annular portion and peripherally spaced, radially extending 
locking projections integrally formed therewith, the length 
of which is short compared with the diameter of said 
cylindrical supporting surface, the free ends of such pro-
jections being adapted to operatively engage such cyl-
drical surface, comprising a cylindrically shaped tubular 
body structure constructed of a material, and having 
the body structure being adapted to be disposed 
with one of its cylindrical surfaces defining the tubular 
construction positioned closely adjacent the cylindrical 
surface of such a supporting element from which a re-
taining device is to be removed, the diameter of said last 
mentioned surface of the body structure having a diameter 
which is such that a relatively close, but free engagement 
may be effected between such surface and the correspond-
ing cylindrical surface of such a supporting element, the 
thickness of the tube wall being less than the radial dis-
tance between the cylindrical surface of such a supporting 
member and the adjacent edge of the annular portion of a 
retaining device engaged therewith, a plurality of 
fingers extending from the opposite end of said body struc-
ture, the number of said fingers corresponding to the num-

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3. A tool according to claim 1 for removing retaining rings having radially extending inwardly directed locking projections constructed for engagement with a cylindrical supporting surface in the form of a cylindrical member, wherein said transversely extending portions have a wedge-shaped cross-section which tapers outwardly from the inner surface of the tubular body structure.

4. A tool according to claim 3, comprising, in further combination, a cylindrically shaped tubular member cooperating with said body structure, having an inner diameter slightly greater than the outer diameter of said body structure to permit reception of the latter in said tubular member, the latter having an end face constructed to bear upon the annular portion of such a retaining device, the inner diameter of said end face being at least equal to the inner diameter of such an annular portion, said tubular member having an axial length less than that of the body structure.

5. A tool according to claim 1, for removing retaining rings having radially extending, outwardly directed locking projections constructed for engagement with a cylindrical supporting surface defining a cylindrical bore in a member, wherein said transversely extending portions have a wedge-shaped cross-section which tapers inwardly from the outer surface of the tubular body structure.

6. A tool according to claim 5, comprising, in further combination, a cylindrically rod-shaped member having an outer diameter which is slightly less than the inner diameter of said tubular body structure to permit insertion therein of said rod-shaped member, the latter having an end face constructed to bear upon the annular portion of such a retaining device, the diameter of said end face being not greater than the outer diameter of such an annular portion, said rod-shaped member having an axial length greater than that of the tubular body structure to enable manual engagement of said member when it is inserted in said body structure.

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