

[54] **PLIERS**

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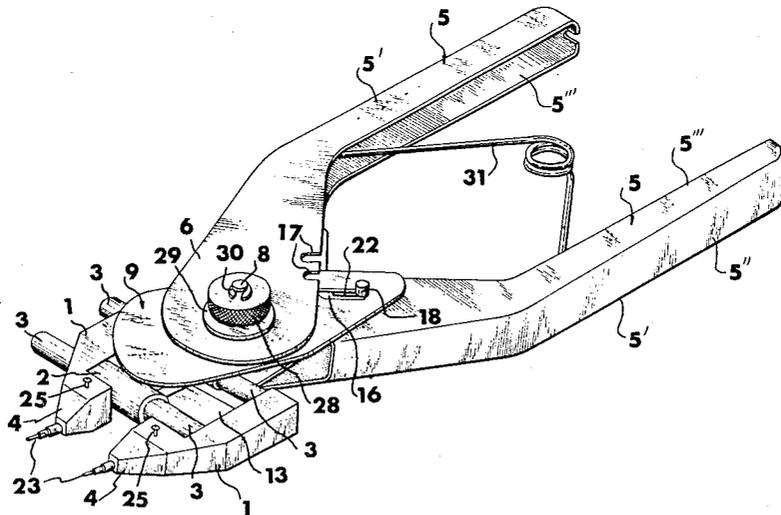
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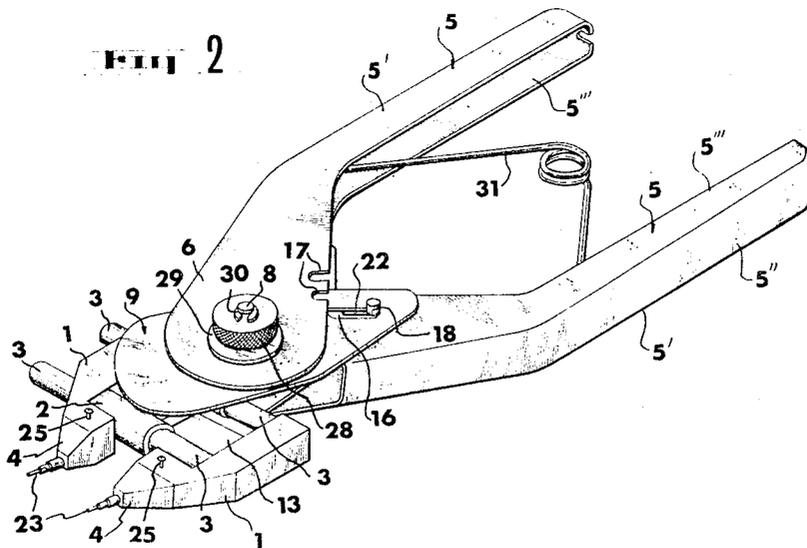
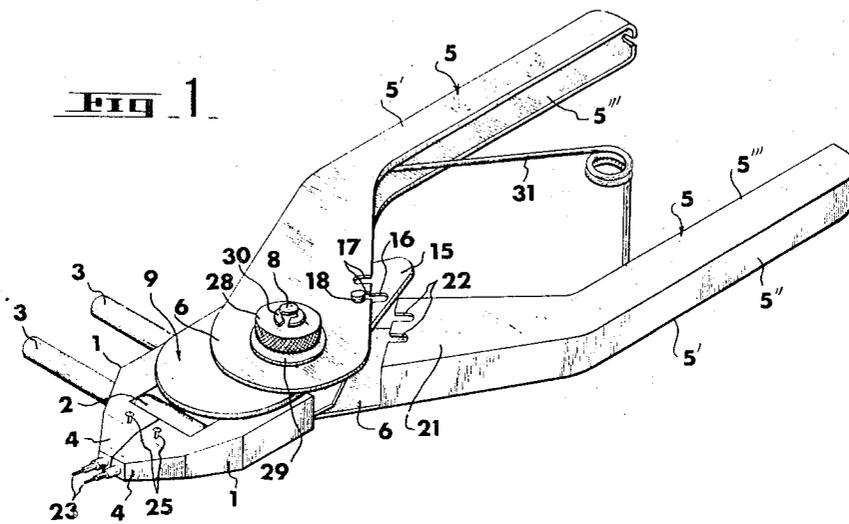
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[57] **ABSTRACT**

Pliers for contracting or expanding snap rings include pivotally connected handles spring biased apart. The handles are coupled to movable jaws by pivotable cam plates. The jaws are guided to move linearly toward and away from each other by parallel slide members. The cam plates carry slidable pins engaging first notches in the handles for moving the jaws apart when the handles are brought together. The pins can engage second notches in the handles for moving the jaws together when the handles are brought together. Other pins having stepped stem portions for engaging holes in ends of snap rings are carried by the jaws.

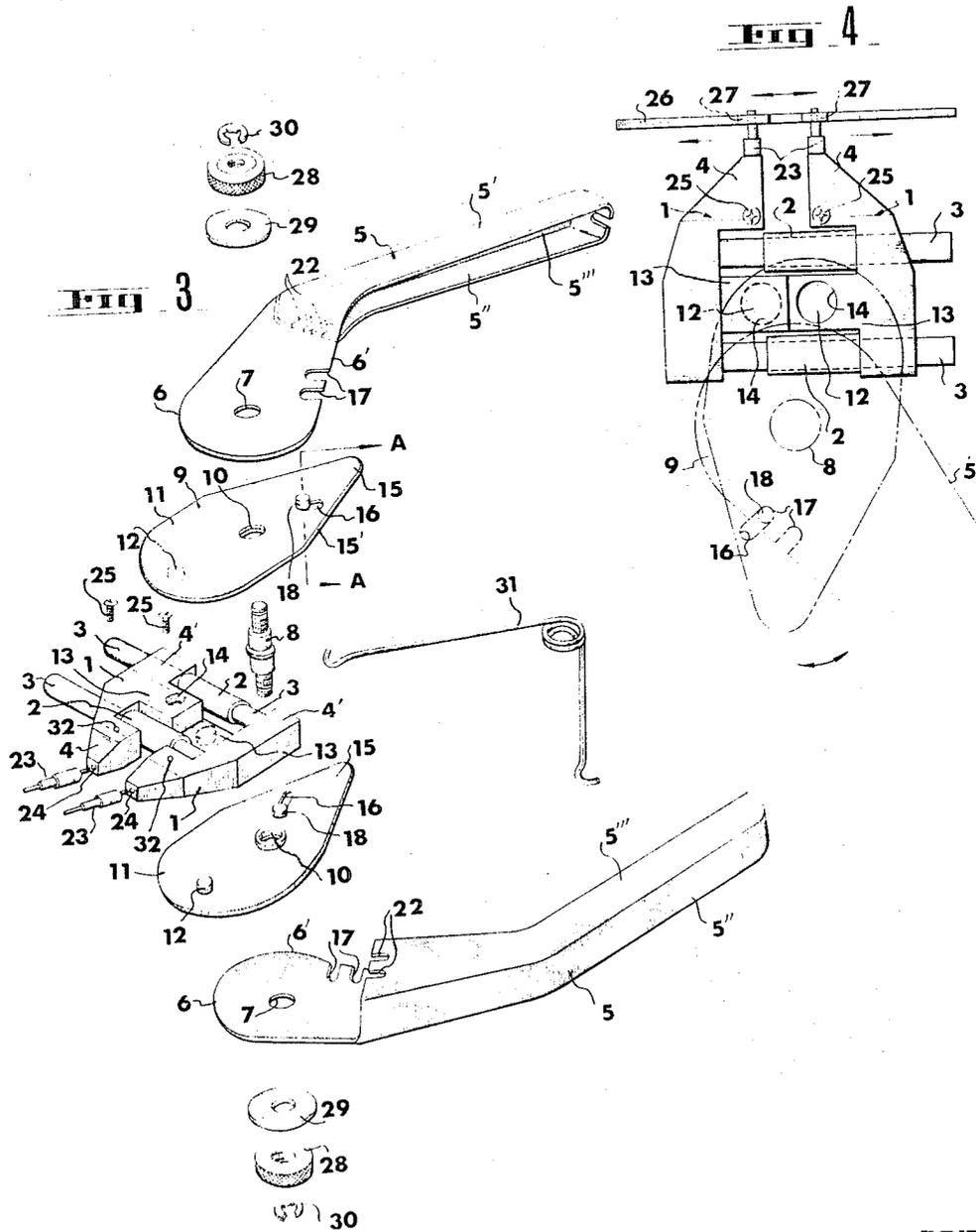
**3 Claims, 10 Drawing Figures**





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FIG 5

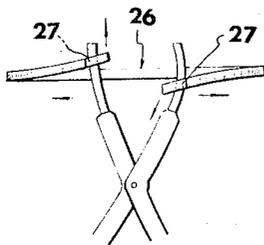


FIG 6

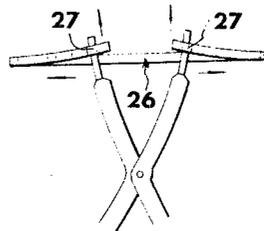


FIG 7

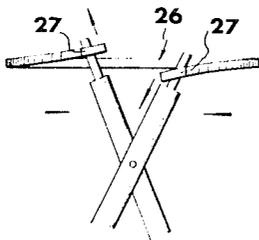


FIG 8

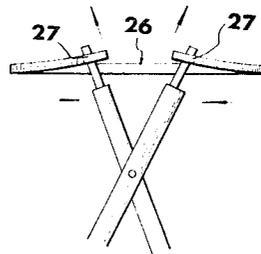


FIG 9

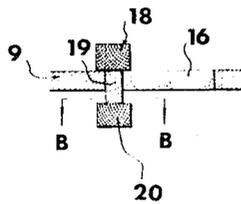
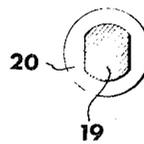


FIG 10



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PLIERS

The present invention relates to the improvements in the pliers used for fitting a snap ring in a recessed peripheral groove formed on the outer peripheral face of a shaft or on the inner peripheral face of the shaft hole so as to prevent axial movement of the members such as bearings, collars and the like which are adapted on the shafts in machines or instruments of various types. The pliers of the present invention comprise a pair of plier heads or jaws each having an engaging pin adapted to engage with each open end of the snap ring, a pair of plier handles arranged to effect the opening and closing of said heads, said plier handles and heads being prepared separately from each other, with said pair of plier heads being coupled together by means of linear motion guiding members fitted slidably with respect to each other, and a pair of cam plates capable of making arcuate motion about the pivot on which said pair of plier handles are mounted movably for their opening and closing performance. Said cam plates are each coupled to the corresponding one of the plier heads and are also so arranged that they are selectively engageable with said plier handles, thereby allowing each of the plier heads to make linear back and forth motion within the same plane through the opening and closing operation of said plier handles and thus enabling the snap ring to properly and correctly expand or contract, as the case may be, in the horizontal direction, thereby to facilitate the operation of mounting or demounting the snap ring in or out of the recessed groove on the outer peripheral face of a shaft or on the inner peripheral face of the shaft hole.

It is known in machinery fabrication that a snap ring is provided in a projected manner to the peripheral face of a shaft or of a shaft-engaging hole to thereby inhibit axial motion of bearings, collars and like members mounted on the shaft. Such snap ring is usually opened at a part and is provided with sufficient elasticity to allow its opening and closing operation. For mounting and fixing this snap ring in position, it is temporarily expanded or contracted by utilizing its elastic disposition and forcefully fitted into a groove formed on the outer peripheral face of a shaft or on the inner peripheral face of a shaft-receiving hole. In the case of fitting the snap ring from outside into a recessed groove formed on the outer peripheral face of a shaft, since the inner diameter of the snap ring arranged to fit the inner diameter of the recessed groove is matter-of-factly smaller than the outer diameter of the shaft, it is required that the user holds with his fingers both open ends of the snap ring, then temporarily expands it and then slides it over the outer peripheral face of the shaft until it reaches the recessed groove, whereat the hold upon the ring is released to restore its normal elasticity whereby the ring is tightly fitted in the groove. While, in the case of achieving desired fitting of the snap ring inwardly into a recessed groove formed on the inner peripheral face of a shaft hole, since the outer diameter of the snap ring, adapted to fit the inner diameter of the recessed groove, is matter-of-factly larger than the inner diameter of the shaft hole, one is required to hold with his fingers both open ends of the snap ring, then temporarily contracts it and then slides it over the inner peripheral face of the shaft hole until it reaches the position of the recessed groove, whereat the hold on the ring is released to restore its normal elastic disposition whereby the ring is fittedly fixed in said recessed groove. Thus the pliers have been utilized as convenient tool for practicing desired fitting of a snap ring in a circumferential groove either by temporarily expanding or contracting it.

Most of the conventional pliers are of a type in which the plier heads or jaws adapted to clasp both open ends of the snap ring are formed integrally with a pair of handles arranged to be laterally movable about a pivot. It needed, therefore, to prepare two types of pliers: one designed for effecting expansion of the snap ring and the other designed for effecting contraction thereof. In order to expand the snap ring, it is required to insert the engaging pins provided at a pair of plier heads into the holes formed at both open ends of the snap ring and to spread said both ends outwardly in a horizontal plane.

In order to contract the snap ring, it is also required to insert the engaging pins provided at a pair of plier heads into the holes formed at both open ends of the snap ring and to converge said both ends inwardly in a horizontal plane.

In this case, concentration of a considerable amount of strong force on the plier heads or jaws is required to effect expansion or contraction against the inherent elastic force of the snap ring. Therefore, during the opening and closing operation of a pair of handles which are moved laterally with their common pivot as fulcrum, it is requested that the user holds said pair of handles with his fingers strongly in the closing direction to thereby achieve desired opening or closing of the jaws. However, since the moving directions of the two jaws are contrary to each other, it is impossible to give two contrary motions, that is to say expanding motion and contracting motion, to the jaws by a single operation of holding the handles in the closing direction. Thus, in the pliers of the type designed for effecting expansion to spread both ends of the snap ring outwardly, a pair of handles each having a head or jaw at its end are pivoted together forming an x-shaped configuration (or more particularly, a configuration formed by placing two "c" letters in back-to-back relation) so that when the user holds the handle portions below the pivot and gives pressure in the closing direction, the head portions above the pivot are accordingly opened. While, in the pliers of the type designed for effecting contraction to close both ends of the snap ring inwardly, a pair of plier handles each having a head or jaw at its end are crossed and pivoted together forming an X-shaped configuration, so that when the user holds the handle portions below the pivot and presses them in the closing direction, the head portions above the pivot are accordingly forced to close or to come together. It is thus of absolute necessity to always have two types of pliers on hand to achieve desired snap ring mounting and demounting operation.

Also, as obvious from the foregoing explanation, these motions of the pliers are such that the head portions or jaws positioned forwardly of the pivot are opened or closed correspondingly to lateral movements of a pair of handles pivoted together, so that it will be noted that the head portions make arcuate motion about the pivot and hence the pins provided at said head portions for engagement with the snap ring are also forced to make arcuate motion. This obviously makes it difficult to attain always precisely horizontal opening and closing motion of both open ends of the snap ring, resulting in producing twist or flexure in the opening and closing strokes or causing slippage or slide on the engaged face between the pins and the holes, and consequently the force applied to the handles often fails to be effectively transmitted to both ends of the snap ring to make it impossible to perform smooth expansion or contraction of the snap ring. In some extreme cases, there is produced such fatal deformation as will deprive the snap ring of its recovering ability, or an enormous amount of labor is required for the mounting and demounting operation for a large snap ring, or engagement between the plier heads and the snap ring is disrupted.

In order to eliminate these defects and realize correct and accurate horizontal motion of the opposed pair of plier heads, the present invention proposes separate formation of said heads and the handles, said pair of heads being coupled together by means of linear motion guiding members arranged to be linearly moved with respect to each other so as to allow the heads to make correct horizontal motion despite the closing motion of the handles about the pivot, thus permitting desired expansion or contraction in the horizontal direction of both open ends of the snap ring. It is also to be noted that a pair of coupling cam plates adapted to be engageable with either of said pair of handles are interposed coaxially between said heads and handles so as to allow said heads to perform two different motions, or opening and closing motions, selectively through approaching motion of the handles, thus realizing utilization of one set of pliers for double purpose of expansion and contraction of the snap ring. Further, the proposed construction of the present invention allows any desired selec-

tion of the length of the backward or forward stroke in the horizontal direction of said pair of heads, and also the composite structure of the snap ring engaging section of the heads can accommodate the wide variety of snap rings of various sizes. Thus, the present invention has realized maximum simplification of the structure of the tool, facilitation of manufacture thereof, and elimination of the troubles or failure.

It is therefore an object of the present invention to provide an improved construction of pliers comprising a pair of head portions having engaging pins adapted to engage with both open ends of a snap ring and a pair of handle portions, said head portions being combined together such that they can make linear approaching and separating motions through a pair of slide members which are arranged to meet said engaging pins at right angles and to be slidable within a same plane in parallel relation to each other, and said head portions being also coupled through a pivot and a spring to a pair of handles which are pivoted together so as to be movable toward or away from each other.

It is another object of the present invention to provide pliers comprising a pair of head portions having engaging pins adapted to engage with both open ends of a snap ring and a pair of handle portions, said head portions being combined together such that they can make linear approaching and separating motions through a pair of parallel slider members which are arranged to meet said engaging pins at right angles and to be slidable within a same plane, said heads being also coupled through a pair of cam plates to a pair of handle portions which are pivoted together so as to be movable toward and away from each other, each of said cam plates having a part thereof supported on the pivot of said handle portions, with one end of said each cam plate being connected to corresponding one of said heads and with the other end being so arranged as to be engageable and disengageable, as so desired, with either of said handle portions through sliding pins.

Still another object of the present invention is to provide an improved construction of pliers in which two spaced cut-outs or dents adapted to receive the sliding pins are formed at different positions of both handle portions for the purpose of coupling said cam plates with desired one of said handle portions, and each of said engaging pins provided at each head of the pliers consists of the engaging portions of different diameters.

Now, the present invention will be described in more detail by way of its fundamental embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a general perspective view of the completed form of a pair of pliers according to the present invention which uses a pair of coupling cam plates and which is of the type in which both open ends of a snap ring are expanded or spread out;

FIG. 2 is a general perspective view of the completed form of a pair of pliers according to the present invention which is of the type in which both open ends of a snap ring are contracted or converged;

FIG. 3 is an exploded perspective view of the component parts constituting the pliers of the present invention;

FIG. 4 is a front view of a pair of plier heads according to the present invention and a snap ring opened thereby;

FIGS. 5 and 6 are respectively a front view of the conventional X-shaped pliers (having a configuration formed by two c's arranged in back-to-back relation) and a snap ring contracted thereby;

FIGS. 7 and 8 are respectively a front view of the conventional X-shaped pliers and a snap ring closed thereby;

FIG. 9 is a sectional view as taken along the line A—A of FIG. 3, showing a sliding pin mounted in a cam plate in the pliers of the present invention; and

FIG. 10 is an enlarged sectional view as taken along the line B—B of FIG. 9.

Referring to FIGS. 1 and 3, there are shown a pair of opposed heads or jaws 1, 1, each of which consists of a gripping or clamping portion 4 and a leg portion 4' integral therewith,

said both portions forming substantially an L-shape in combination. In the top face of said gripping portion 4 is formed an opening 24 which is parallel to said leg portion 4' and adapted to receive therein a pin 23 engaged with either of the two open ends of a snap ring. Said each gripping portion 4 has also formed therein a threaded hole 32 which is perforated from one side of said portion 4 towards said opening 24, and a screw 25 is passed into said threaded hole to thereby secure the pin 23. It will also be noted that each pin 23 consists of the stem portions of different diameters which are gradually enlarged towards the proximal end as shown. This construction provides versatility in accommodating various types of snap rings whose engaging holes at both open ends thereof may vary in size according to the type of the ring, such as shown in FIG. 4.

On the inside and centrally in the length of each said leg portion 4' of the head 1 is provided, in projected form, a wall block 13 having a thickness half that of the leg portion 4'. Such wall blocks 13, 13 of both leg portions 4', 4' are positioned in opposed but staggered relation to each other so that they will not run against each other but will be superposed one on the other when said heads 4, 4 come together or are closed. In the external face of each said wall block 13 is formed a dent or hollow 14. On the inside of said leg portions 4', 4' are also provided a pair of linear motion guiding slider assemblies each consisting of a tubular sliding member 2 and a rod-like sliding member 3 and arranged in parallel relation while flanking said wall blocks 13, 13 as shown. It is to be noted that the rod-like sliding member 3 is provided with sufficient length to pass through the thickness of the leg portion 4' where the tubular sliding member 2 is provided. It should be also noticed that both sliding members 2 and 3 are positioned exactly at right angles to the leg portions 4', 4' of the heads 1, 1 and located in the same plane, so as to allow the heads 1, 1 to make linear motion, either in the opening or in the closing direction, precisely in the same plane in the manner to be described later more particularly.

Designated by reference number 5, 5 are a pair of handles. As will be seen, the grasping portion of each handle 5 consists of three walls 5', 5'' and 5''' which constitute a hollow structure U-shaped in section. Each wall 5' terminates into a flat-shaped plate 6 having formed substantially in its center a hole 7 through which a pivot is passed. It will also be noted that plural cut-outs or notches 17 are provided along a part of the inner edge 6' of said plate 6, and at the top edge of the wall 5''' are formed plural similar cut-outs or notches 22 which correspond to cut-outs 17 in the other handle.

Reference number 9, 9 indicates a pair of cam plates adapted to couple said heads 1, 1 to the respective handles 5, 5. Each said cam plate 9 is made of a flat plate consisting of acircular head portion 11 and a V-shaped tail portion 15 and has formed substantially in its center a pivot-receiving hole 10 aligned with the holes 7, 7 in the handles 5, 5. Adjacent to the inner edge 15' of said tail portion 15 is formed an elongated slot 16 in which a sliding pin 18 is slidably fitted through a countersunk screw 19 and a nut 20 so that said pin can slide along the full length of the slot 16. The pin 18 is non-circular in sectional shape so that it won't rotate idly. At the circular head portion 11 of said each cam plate 9 is also provided a pin 12.

Also in the drawings, reference number 8 designates a shaft on which said handles 5, 5 as well as said cam plates 9, 9 are pivoted, 28 check nuts, 29 washers, 30 snap rings mounted at both ends of the pivot 8, and 31 a spring interposed between both handles 5, 5.

Described and shown hereinbefore is an embodiment where a pair of cam plates 9, 9 are provided as medium means in the coupling mechanism of the heads 1, 1 and the handles 5, 5 of the pliers. As will be understood from the foregoing discussion, the assemblage of the present device follows the following steps: First, a pair of head or jaw blocks 1, 1 are combined together in parallel relation to each other, with a pair of slider assemblies 2, 3 being mounted therein as shown in FIGS. 3

and 4. Then, a pair of cam plates 9, 9 are mounted in such a manner that the head portions 11, 11 thereof are placed in a superposed manner on the external faces of said head blocks 1, 1 and that the pins 12 formed on said head portions 11 are fitted in the respective holes 14 in the connecting walls 13 formed at the leg portions 4' of the head blocks 1. Then a pair of handles 5, 5 are fixed such that the flat plates 6, 6 at the ends of the walls 5', 5' are overlapped on the external faces of said cam plates 9, 9, with the openings 7, 7 in said flat plates being aligned with the corresponding openings 10, 10 in said cam plates, and a pivot 8 is passed through said openings 7, 7 and 10, 10 and fixed in position by means of check nuts 28 and washers 29. When it is desired to expand the snap ring 26, a sliding pin 18 slidably engaged in an elongated slot 16 in each cam plate 9 is engaged in one of the cuts-out 17 formed in the flat plate 6 of each handle 5 on the same side as said cam plate 9 as shown in FIG. 1, while when it is desired to contract the snap ring 26, said sliding pin 18 is engaged in one of the cuts-out 22 formed in the wall 5''' of the handle 5 on the opposite side of said cam plate 9 as shown in FIG. 2. It will also be noted that a spring 31 is interposed between the two handles 5, 5 to keep them normally in a spread out state.

In an alternative embodiment, a pair of handles 5, 5 may be directly joined to the head blocks 1, 1 without using the cam plates 9, 9. In this case, the handles 5, 5 are pivotally secured by the pivot 8 and pins 12, 12 are formed on the flat plates 6, 6 of the handles 5, 5, and these pins are fitted in the respective holes 14, 14 in the connecting walls 13, 13 of the head blocks 1, 1. It should, however, be noted here that in the case of expanding the snap ring 26, the handle 5 and head block 1, which are associated, are of the same side, while in the case of contracting the snap ring 26, the associated handle 5 and head block 1 are of the opposite side from each other.

The present invention, which has the above described construction, will now be described from the aspect of expansion or contraction of the snap ring. When the sliding pin 18 on the cam plate 9 is fitted in a cut-out 17 in the flat plate 6 of each handle 5 as shown in FIG. 1, said handle 5 and the cam plate 9 on the same side are integrated with each other, thus allowing the head block 1 on the same side as said handle 5 to move integrally therewith, so that if the user grasps the handles 5, 5, which are normally opened or spread out by spring 31, and compresses them in the closing or mutually approaching direction in the same manner as any of the conventional X-shaped pliers, the cam plates 9, 9 will be urged to revolve about the pivot 8 contrariwise to movement of the handles 5, 5, causing the head blocks 1, 1, which are integrated with pins 12, 12, through connecting walls 13, 13, to move also contrariwise to moving direction of the handles 5, 5. Since both head blocks or jaws 1, 1 are coupled together by means of slide elements 2, 3, they move away from each other linearly and horizontally in the same plane despite arcuate movement of the cam plates 9, 9, whereby both open ends of the snap ring 26 engaged with the engaging pins 23, 23 of the head blocks 1, 1 are spread out correctly in the horizontal direction as indicated by arrows in FIG. 4, thereby to facilitate the operation for fitting the snap ring in a recessed groove formed around the peripheral face of the shaft. If the hold on both handles 5, 5 is released, they will be forced back to the normal spread-out condition by spring 31, causing the head blocks or jaws 1, 1 to return to the original closed position of FIG. 1, through guidance of the slide elements 2, 3.

On the other hand, if the sliding pin 18 on each cam plate 9 is engaged in a cut-out 22 formed at the top end of the wall 5''' of the handle 5 on the opposite side, the handle 5 and the head block 1, which are on the opposed sides, will be coupled together through the corresponding cam plate 9. When the handles 5, 5 are kept in an opened or spread out condition by spring 31, the head blocks or jaws 1, 1 remain in an opened position through slide elements 2, 3 in the same manner as the conventional X-type pliers, so that if the pins 23, 23 are engaged in the holes 27, 27 at both open ends of the snap ring 26 and the user grasps the handles 5, 5 and presses them towards

each other, the arcuate rotation of the cam plates 9, 9 about the pivot 8 is transmitted to the head blocks 1, 1 to allow them to move towards each other linearly and in the exactly horizontal direction in the same plane through guidance of slide elements 2, 3, in the manner just contrary to that described in connection with FIG. 4, thereby achieving desired contraction of the snap ring 26.

Thus according to the present invention, in either case, by using a pair of cam plates 9, 9 for coupling purpose and by selectively engaging each sliding pin 18 in one of the cuts-out 17 or in one of the cuts-out 22, it is possible to let a pair of head blocks 1, 1 move away from or toward each other always linearly in a same plane by single grasping operation of the handles 5, 5, thus realizing performance of two different operations, or expansion and contraction of the snap ring 26 with single pair of pliers.

Also in any case, greater versatility is obtained by providing more number of cuts-out 17 and 22 in the form of groups, because it is possible, by so doing, to change the distance of the linear opening and closing strokes of the head blocks 1, 1 through the medium of slide elements 2, 3, by suitably selecting one of said cuts-out in which the sliding pin 18 is to be engaged. Also, the fact that each of the engaging pins 23, 23 is composed of the stepped stem portions of different diameters provides greater accommodation for various types of snap rings having different sizes. Namely, a stem portion best suited for the engaging holes 27 at both ends of a snap ring, which will vary in diameter according to the type of the ring used, may be selected out of many such portions to thereby insure positive operation.

As will be obvious from the foregoing explanation, the pliers according to the present invention are conspicuously advantageous in the following points as compared with the conventional X-type or x-type pliers.

According to the conventional type pliers, no matter whether they are of an x-type as shown in FIGS. 5 and 6 or of an X-type as shown in FIGS. 7 and 8, the handles and the heads are formed integrally, that is to say, each handle and head are made of a single structure, so that when the handles are moved toward each other with their common pivot as its fulcrum, the heads or jaws, which are integral with the handles, are obliged to make a corresponding motion describing a circular arc centering round said pivot. Therefore, the motion given to the snap ring 26 for its expansion or contraction through the heads engaged with the holes 27 of said ring can not produce an exactly linear movement in a same plane but rather invites twist, flexure or other deformation in the ring itself or at its open ends as shown. There may also be caused slippage at the engaged sections, with resultant poor concentration of the effective force. These undesirable factors combined make it difficult to achieve smooth motion on the outer peripheral face of a shaft or on the inner peripheral face of a shaft hole, hence the awkward snap ring mounting and demounting operation. In some cases, even such fatal deformation as will completely spoil recovering capacity of the snap ring may take place.

In contrast, according to the present invention, a pair of head blocks or jaws 1, 1, which are structurally separate from the handles 5, 5, can make an exactly linear motion in a same plane through the aid of slide elements 2, 3, in a manner different from motion of the handles, so that desired expansion or contraction of the snap ring 26 can be performed always correctly without producing any bit of twist or bending. Also, no slippage takes place with the pins 23, 23 engaged in the holes 27, 27, and the grasping force applied on the handles 5, 5 is transmitted with no loss, thus permitting smooth and quick achievement of expansion or contraction of the ring 26 in a perfect matter. There is also no fear of inviting "fatal" deformation of the ring. Further, use of the coupling cam plates 9, 9 permits performance of both expansion and contraction of the snap ring with single pair of pliers by simple operation of engaging a sliding 18 with either of the handles 5, 5, thus completely eliminating the necessity of preparing two dif-

ferent types of pliers which was a must in conventional practice. Moreover, the present device, for its unique construction of the head assemblies 1, 1 allowing desired change of distance of their moving strokes and of the engaging pin assemblies 23, 23, can be adapted for various types of snap rings which range widely in size, thus realizing easy and highly efficient mounting and demounting of a wide variety of snap rings in a desired location with a single piece of tool. In addition, all that is required for constitution of the present device is simple assemblage of a pair of head blocks 1, 1, a pair of handles 5, 5 which are formed separate from said head blocks, and a pair of cam plates 9, 9. Thus, the entire construction of the present device is comparatively simple, so that it has no difficulties in manufacture or in operation and is free of troubles or failures which are inevitably encountered in a complicated structure or assemblage as of the conventional known devices. It is to be understood of course that all the changes and modifications in design which come within the range of the present invention are to be embraced therein.

What is claimed is:

1. Pliers comprising a pair of coplanar relatively movable jaws; first pins carried by the respective jaws and respectively engageable with holes in ends of a snap ring; a pair of parallel slide elements connecting the jaws so that the jaws are movable toward and away from each other linearly in the plane of the jaws, said slide elements being arranged at right angles to

the pins and slidable linearly in the plane of the jaws; a pair of handles; pivot means pivotally connecting the handles; spring means interposed between the handles tending to bias the handles apart; a pair of cam plates pivotally secured to said pivot means, one end of each cam plate being coupled to a different one of the jaws; and slidable second pins coupling other ends of the cam plates to selective means on the handles respectively so that the jaws are coupled to the handles by the cam plates, and said jaws being movable toward or away from each other linearly in said plane depending on the positions of the slidable second pins with the selective means on the handles when the handles are moved toward each other.

2. Pliers as defined in claim 1, wherein said selective means includes a first group of spaced notches is formed in the handles for engagement by the sliding second pins so that the jaws move toward each other when the handles are moved toward each other, and a second group of spaced notches formed in the handles for engagement by the sliding second pins, so that the jaws move away from each other when the handles are moved toward each other for expanding the snap ring.

3. Pliers as defined in claim 1, wherein each of the first pins comprises a plurality of stem portions of different diameters varying stepwise, so that each stem portion will fit snugly in an opening of different diameter in an end of a snap ring.

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