June 16, 1964 K. WEISSER 3,137,276

PROTRACT-RETRACT MECHANISM AND WRITING INSTRUMENT INCLUDING SAME

Filed Aug. 30, 1955 2 Sheets-Sheet 1

FIG. 1

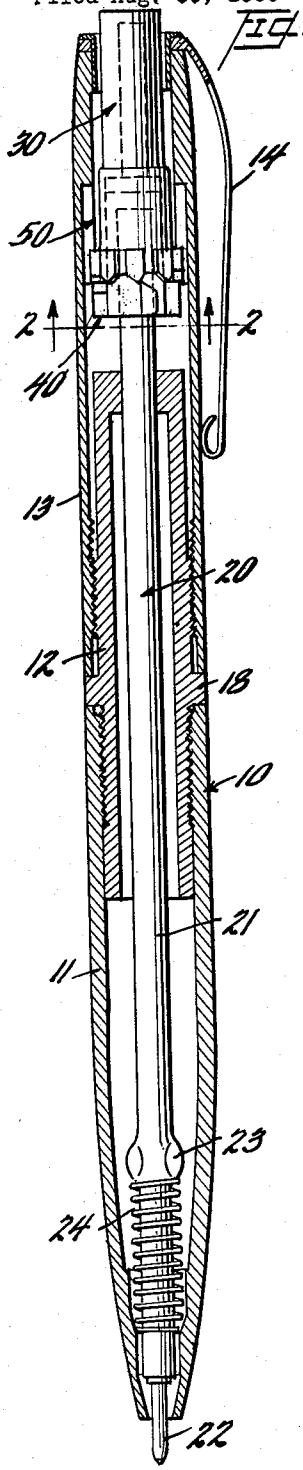


FIG. 2

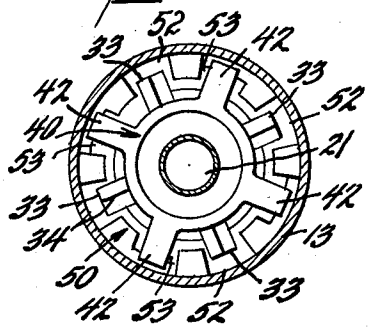


FIG. 3

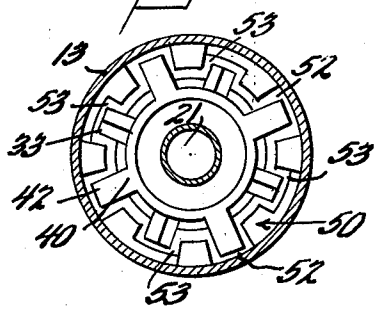


FIG. 4

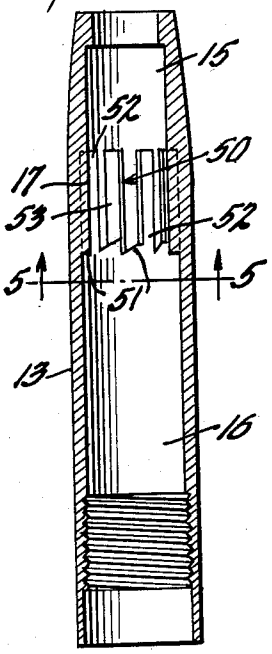


FIG. 6

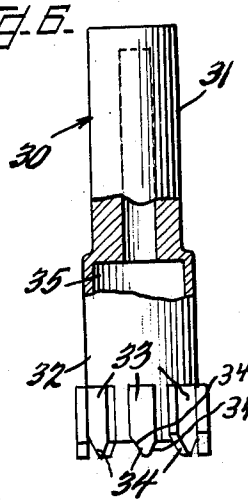


FIG. 5

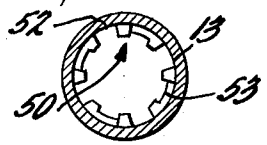
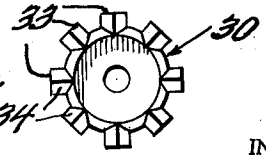


FIG. 7



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PROTRACT-RETRACT MECHANISM AND WRITING INSTRUMENT INCLUDING SAME

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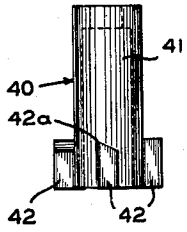
FIG. 8



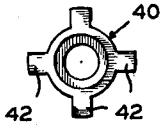
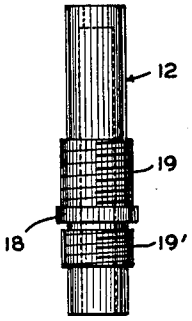


FIG. 9

FIG. 10



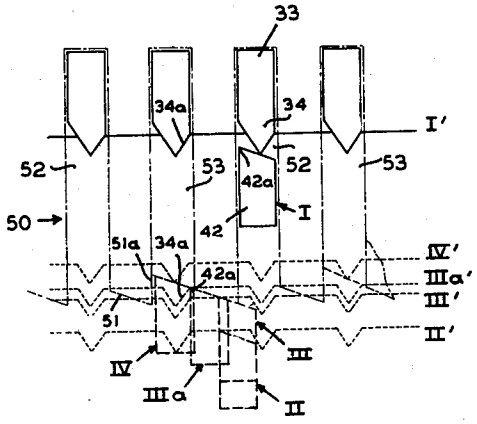


FIG. 11

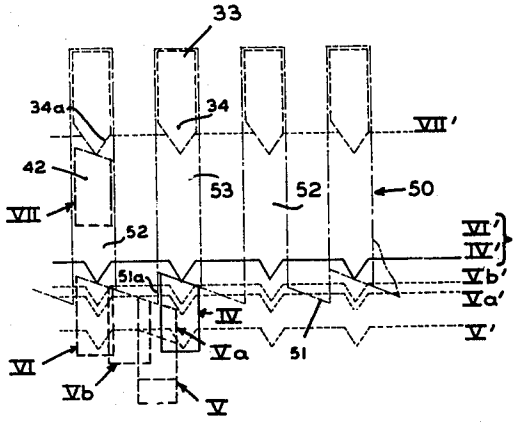


FIG. 12

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United States Patent Office 3,137,276 Patented June 16, 1964

3,137,276

PROTRACT-RETRACT MECHANISM AND WRITING INSTRUMENT INCLUDING SAME

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Filed Aug. 30, 1955, Ser. No. 531,460
17 Claims. (Cl. 120—42.03)

The present invention relates to improvements in protract-retract mechanisms and parts therefor, and in writing instruments including same and more particularly to new and improved push-button operated mechanism for protracting the writing tip of a writing instrument into an exposed writing position and retracting the writing tip into a retracted position within a protecting barrel.

In accordance with the invention, a cartridge unit carrying a writing tip is resiliently biased toward the rear of a protecting barrel and a push button is employed so that a first depression of the push button will propel the cartridge unit forwardly whereupon release of the push button will leave the writing tip locked in a protracted position and a second depression and release of the push button will retract the writing tip into a position where the sequence of protraction and retraction can be repeated.

More particularly, the forward extremity of the push button is formed with forwardly projecting cam teeth and the push button is mounted for vertical, non-rotating reciprocation with an internal gear fixed to the interior of the surrounding casing. The internal gear is provided with longitudinal channels which are spaced by forwardly projecting cam teeth positioned at the lower end the channels. A longitudinally reciprocable and rotatable member carrying outwardly extending cam lugs is also provided, these lugs being adapted to ride in the channels and engage the teeth of the internal gear. The cartridge unit is mounted to reciprocate with the lug carrying member so that the writing tip is retracted when the lugs ride upwardly in the channels and is protracted when the lugs engage the cam teeth of the internal gear. The novel construction of the invention enables great savings to be effected, for despite the highly desirable operation which is achieved, the parts required are few in number and inexpensively producible and the pen assembly produced from these parts is easily assembled to produce the desired product. Also, the construction of the invention presents a new and different operation in that the cam lugs which engage the teeth of the internal gear and ride in the channels thereof are only acted upon in one direction by the teeth of the internal gear and the teeth of the push button.

An object of the invention is the provision of novel push button operated protracting and retracting means of simplified design and construction.

A further object of the invention is the provision of push button operated protracting and retracting means having simplified construction in which the push button carries downwardly projecting cam teeth and is mounted for longitudinal reciprocation but is not rotatable with respect to the barrel in which it reciprocates.

Another object of the invention is the provision of simplified push button operated protracting and retracting means in which the push button carries downwardly projecting cam teeth and the cartridge unit and push button are biased by a single spring.

It is also an object of the invention to provide a novel protract and retract mechanism operated by a push button in which all of the operating parts of said mechanism can be formed from injection molded pieces of plastic

and in which the operating mechanism can be simply and quickly assembled.

Still another object of the invention is the provision of novel protract-retract mechanism operated by a push button and operating on the principle of a continuous cam in which the continuous cam is formed integrally with the interior of the barrel within which the cartridge unit is confined.

It is also an object of the invention to provide a novel protract-retract mechanism operated by a push button which is adapted for employment in conjunction with conventional cartridge units and which enables the cartridge unit to be extracted and replaced when the ink therein has become exhausted.

Other and further objects of the invention will become apparent from the description which follows taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is an elevation of a ball pen assembly constructed in accordance with the invention with the barrel broken away and in section and showing the writing tip in protracted position;

FIGURE 2 is a section taken on the lines **2—2** of FIGURE 1;

FIGURE 3 is similar to FIGURE 2 with the pen assembly in retracted position;

FIGURE 4 is an elevation in section of the upper casing portion of the barrel and showing the internal gear;

FIGURE 5 is a section taken on the lines **5—5** of FIGURE 4;

FIGURE 6 is an elevation of the top button spur gear with a portion thereof broken away and in section;

FIGURE 7 is a bottom view of the top button spur gear shown in FIGURE 6;

FIGURE 8 is an elevation of the rotating lug member;

FIGURE 9 is a bottom view of the rotating lug member shown in FIGURE 8;

FIGURE 10 is an elevation of the intermediate holder to which the upper and lower casings are secured to form the barrel of the pen assembly;

FIGURE 11 is a diagrammatic developed elevation depicitng the protracting operation and showing the internal gear with its channels and teeth in dot and dash lines, the original position of the lugs on the top button spur gear and rotating member in full lines and the intermediate positions in dotted lines;

FIGURE 12 is similar to FIGURE 11 and depicts the retracting operation, with the initial position of the top button spur gear and the initial position of the lug on the rotary member being shown in full lines.

Referring to FIG. 1 which illustrates a ball pen assembly constructed in accordance with the invention, a barrel indicated generally at **10** in the illustrated embodiment includes a lower casing **11**, an intermediate holder **12** and an upper casing **13**. A clip **14** may be secured to the barrel **10** in any suitable manner. Within the barrel **10** is a cartridge unit **20**, which is of conventional type, and includes a reservoir **21**, a writing tip **22** and outwardly extending abutment means **23**. The cartridge unit **20** is mounted for longitudinal sliding reciprocation within the barrel **10** and a spring **24** surrounds the lower end of the reservoir **21** and abuts the abutment means **23** on the one hand and the forward portion of the barrel **10** on the other hand to urge the cartridge unit **20** toward the rear of the barrel into retracted position.

The upper casing **13** of the barrel **10** contains the protracting and retracting mechanism of the invention which includes a top button spur gear **30**, a rotating lug member **40**, and an internal gear **50** which, in accordance with a feature of the invention, is formed integral with the upper casing **13** so that the upper casing **13** and the internal gear **50** can be constituted by a single injection

molded piece of plastic. Further, in accordance with the invention, the top button spur gear **30** and the rotating lug member **40** can also be constituted by injection molded pieces so that every element of the protracting and retracting mechanism may be simply and economically manufactured to achieve a superior mechanism at greatly reduced cost. As will later more fully appear, the parts of the protracting and retracting mechanism are not only capable of being economically manufactured, but these parts can be easily assembled to constitute the ball pen assembly illustrated in FIG. 1.

Referring to FIGS. 4 and 5, the upper casing **13** is tubular and is formed with a rear portion **15** of reduced internal diameter, a forward portion **16** of enlarged internal diameter and an intermediate portion **17** in which the internal gear **50** is formed.

As can be seen in FIG. 1, the rotating lug member **40** fits upon the rear end of the cartridge unit **20** and the top button spur gear **30** fits upon the rear of the rotating lug **40**. In assembled condition, the button portion of the top button spur gear projects from the upper open end of the upper casing **13** and lugs on both the top button spur gear **30** and the rotating lug member **40** are positioned in channels in the internal gear **50** (see FIGS. 2 and 3).

Referring more particularly to FIGS. 6 and 7, the top button spur gear **30** is provided with an upper button portion **31** and a lower gear portion **32**. The gear portion **32** is provided with radially spaced outwardly extending lugs **33** and the lower end of the gear portion **32** is provided with teeth **34**, defined by surfaces or faces **34***a* and **34***b*, which are inclined toward each other and the axis of the push button so that the lower points of the teeth **34** are generally centrally positioned with respect to the lugs **33**. More particularly, and this can be seen in the side elevation shown in FIG. 6, the lower points of the teeth **34** provide a toothed lower end for each of the lugs **33**. The lower end of the top button spur gear **30** is provided with a cylindrical cavity or recess **35** to enable the upper portion of the rotating lug member **40** to be rotatably received within the gear portion **32** of the top button spur gear **30**.

Referring to FIGS. 8 and 9, the rotating lug member **40** is provided with an upper portion **41** which, as previously indicated, is received within the recess **35** of the top button spur gear **30**. The lower end of the rotating lug member **40** is provided with outwardly extending lugs **42**. At this point and with reference to FIGS. 2 and 3, it should be noted that the lugs **42** on the rotating lug member **40** have a greater diameter than do the lugs **33** on the top button spur gear **30**.

The internal gear **50** is shown in FIGS. 4 and 5 from which it will be seen that the internal gear **50** is formed integral with the interior of the rear portion **15** of the upper casing **13** and is constituted by a plurality of downwardly extending teeth **51**, deep channels **52** and shallow channels **53**. The lugs **42** on the rotating lug member **40** fit within the deep channels **52** but are of too great a diameter to fit within the shallow channels **53**. The lugs **33** on the top button spur gear **30** are sufficiently small in diameter to fit within both the deep channels **52** and the shallow channels **53**. The relative diameters of the lugs and channels can be seen in FIGS. 2 and 3. There are two teeth **51** between each of the deep channels **52** and the teeth **51** together with the deep channels **52** constitute a continuous cam of known type. However, unlike known constructions employing a continuous cam, it will be observed that both the continuous cam of the internal gear **50** and the cam teeth **34** of the top button spur gear **30** point downwardly so that no limiting cam track is provided.

To assemble the ball pen assembly shown in FIG. 1, the cartridge unit **20** with the spring **24** thereon is inserted in the lower casing **11** and the intermediate holder **12** is placed upon the cartridge unit **20** and secured to the lower casing **11** by the threaded connection shown in FIG. 1. The intermediate holder **12** is shown in FIG. 10 and is tubular and comprises an intermediate band **18** and threaded portions **19** and **19'**. The intermediate holder **12** functions to retain the cartridge unit **20** in the lower casing **11** and provides means for supporting the upper casing **13**. The intermediate holder **12** also functions as a guide for the cartridge unit **20** and retains this unit centrally positioned within the lower and upper casings **11** and **13**.

After the intermediate holder **12** has been secured to the lower casing **11**, the rotating lug member **40** is seated upon the upper end of the reservoir **21** of the cartridge unit **20** and the top button spur gear **30** is seated upon the upper portion **41** of the rotating lug member **40**, the upper portion **41** being received within the cavity or recess **35**. The upper casing **13** is then placed upon the assembly and pushed downwardly so that the lugs **33** on the top button spur gear ride up within the channels **52** and **53** in the internal gear **50**. When this occurs, the upper casing **13** is screwed home upon the intermediate holder **12** and the pen assembly is thereupon completed and the push button operated protract-retract mechanism is ready for operation.

Replacement of an exhausted cartridge unit is far simpler than its original construction because the upper end of the intermediate holder **12** is positioned close to the lower end of the internal gear **50**, as can be seen in FIG. 1, and as a result, removal of the cartridge does not destroy the alignment or positioning of the top button spur gear **30**, the rotating lug member **40** and the internal gear **50**.

The operation of the device of the invention is illustratively depicted in FIGS. 11 and 12. Referring to FIG. 11, this figure diagrammatically presents the protracting sequence. With reference to the dash and dot lines, these lines represent a developed view of the internal gear **50** and show the deep channels **52**, the shallow channels **53** and the downwardly inclined teeth **51**. The full lines show the lugs **33** on the top button spur gear **30** in their initial retracted position with the lugs **33** seated in the rear of the channels **52** and **53**. Also shown in full lines is one the lugs **42** on the rotating lug member **40**, the lug **42** being biased against the tooth **34** of the lug **33** in the deep channel **52**.

This figure shows four of the lugs **33**, but only one lug **42** is shown since the movement of one lug together with a pair of lugs **33** of the push member adequately illustrate the operation of the mechanism. In FIG. 11 the successive positions of lug **42** are indicated by numerals I, II, III, III*a* and IV while the corresponding positions of the push button are indicated by the numerals I', II', III', III*a*'' and IV'. As stated above, the initial retract position of the push button and the lug **42** is shown in full lines. This position is indicated by numerals I and I'. The successive positions of lug **42** are shown in long dash lines and the subsequent positions of the push member are shown in short dash lines. During the operation illustrated in FIGS. 11 and 12, the spring **34** urges lug **42** upwardly, that is, toward the push button **30** and, for purpose of simplicity, spring **24** is not shown in FIGS. 11 and 12.

As can be seen by the full lines, the lug **42** in the retracted position is in the upper portion of the deep channel **52** where it abuts against the tooth **34** of the lug **33**. The upper end of the lug **42** is inclined so that the tooth **34** has a tendency to move the lug **42** to the left (which would rotate the rotating lug member **40**). This motion of the lug **42** and resulting motion of the rotating lug member **40** is prevented by the side walls of the deep channel **52** as can be more clearly seen by reference to FIG. 3. When the push button **30** is depressed, the lugs **33** are moved downwardly, one in each of the channels **52** and **53** and the lugs **42** on the rotating lug member **40** are forced downwardly by the lugs **33**. The downward motion of the lug **33** moves the

lug 42 downwardly in the channel 52 until the upper end of the lug 42 clears the lower end of the channel 52 which releases the lug 42 for rotational movement. Accordingly, when the lug 33 reaches the bottom of its downward stroke, the lug 42 has also reached the bottom of its downward stroke and has been moved slightly to the left so that at least a portion of lug 42 is opposite tooth 51 of the internal gear, as indicated by the position identified by the numeral II, the position of the push button being identified by the numeral II'. When the push button 30 is then released, the spring 24 urges the lugs 42 upwardly against the push member and as the spring 24 continues acting on lugs 42 the top edge or surface 42*a* of the lug urges the push member upwardly until the top of the lug 42 contacts the bottom of the teeth 51 on the internal gear. This point is identified by the numeral III and III'. The spring 24 urges lug 42 into engagement with the bottom of tooth 51 and because of the inclination of the bottom of tooth 51, the force of engagement between the opposed lug 42 and tooth 51 rotatably biases lug 42 and lug 42 then slides along the lower inclined face of tooth 51 and contacts the inclined right hand face 34*a* of tooth 34 in shallow channel 53, the push button being moved upwardly to position III*a*', numeral III*a* indicating the position of the lug 42 at this point.

At this point the rotatable bias of the rotatable member urges the top surface 42*a* of lug 42 against the inclined right hand face 34*a* of tooth 34 and the inclination between these interengaging surfaces translates the rotatable bias of the rotatable member into an upward force against tooth 34 which force urges tooth 34 upward into shallow channel 53 while the lug 42 continues to slide along the inclined lower face of tooth 51 until it is stopped by the lower edge of the succeeding tooth 51, said lower edge being indicated by reference numeral 51*a* which acts as a stop surface to prevent rotation of the lug 42.

The positions of lug 42 and push member at this point are indicated by the numerals IV and IV'. It is apparent that at this point, IV and IV', the push member is in an operative position for a successive depression, that is, the push member is so positioned that teeth 34 are above the lug 42 whereby a subsequent depression of the push member will remove lug 42 from between adjacent teeth 51 and out of engagement with lower edge 51*a* while rotatably biasing lug 62.

It will be appreciated that in the position IV, the lug 42 underlies the shallow channel 53 and represents the protracted position. The lug 42 is of too great a diameter to fit within the shallow channel 53, as can be seen in FIG. 2, and hence the writing instrument is locked in a protracted position by the lower face of the shallow channel 53 with rotation of the rotating lug member 40 being prevented by engagement of the lug 42 with the teeth 51.

The retraction sequence is diagrammatically illustrated in FIG. 12, the initial positions of lug 42 and the push member being shown in full lines indicated by numerals IV and IV', these positions corresponding to the last position shown and described in connection with FIG. 11 and showing the writing instrument in the projected position. In FIG. 12, numerals V, V*a*, V*b*, VI and VII show successive positions of the lug 42 while numerals V', V*a*', V*b*', VI' and VII' show successive positions of the push button. Depression of the top button spur gear 30 moves the lugs 33 downwardly until the lug 42 clears the bottom of the shallow channel 53 including stop surface 51*a*, at which time the cam action previously described moves the lug 42 to the left, where it occupies the position identified by the numeral V when the top button spur gear is at the lowest point in its downward movement. The position of the push button at this point is identified by the numeral V'. Therefore,

when the top button spur gear 30 is released, the spring 24 urges the lug 42 upwardly toward the opposite tooth 51 until the lug 42 contacts the inclined lower face of the tooth 51, the lug 42 acting against the push member so that the lug 42 and the push member assume the positions indicated by numerals V*a* and V*a*'. Then, as described in connection with FIG. 11, the lug slides to the left and simultaneously urges the tooth 34 upwardly, the lug going through the positions indicated by the numerals V*b* and VI and the push member going through the positions indicated by the numerals V*b*' and VI'.

It is pointed out that the positions VI and VI' correspond to positions IV and IV' of FIG. 11. However, since channed 52 is a deep channel, lug 42 can slide in this channel, and, therefore, the lug 42 then slides upwardly while forcing the lug 33 to the top of the channel. This represents the retracted position and is identified by the numerals VII and VII'. This retract position is identical with the initial position identified by numerals I and I' in FIG. 11.

Thus, it is evident that at least one of the engaging surfaces of the teeth of the push member and the rotatable member is so inclined that the force of engagement between the teeth of the push member and the engaging surface of the rotatable member caused by the spring, rotatably biases the rotatable member when the push member is depressed. In addition, another of the engaging surfaces of the teeth of the push member and the rotatable member is so inclined that the force of engagement between the teeth of the push member and the engaging surface of the rotatable member caused by the spring, upwardly biases the push member to the operative position when the push member is released.

As will be evident, the rotating lug member 40 carries a plurality of lugs 42, one for each of the deep channels 52 and the action in each of the deep channels 52 is identical. It will also be evident that when one sequence of protraction and retraction has been completed, the sequence of operations can be repeated endlessly with the lugs 42 moving from channel to channel as the rotating lug member 40 rotates within the upper casing 13. In the course of this rotation, which is always in the same direction, the lugs cooperate in turn (*a*) with cam teeth 51 of one character, i.e., those having an inclined surface succeeded by a stop surface, (*b*) with cam teeth 51 of another character, i.e., those having an inclined surface leading into a deep channel 52, and (*c*) with these deep channels themselves so that a cam tooth 51 of one character plus a cam tooth 51 of the other character plus a deep channel 52 may be considered to constitute a cam element, the embodiment illustrated comprising a plurality of such cam elements. The lug or projection 17 may also be called a lug element, there being four lug elements in the illustrated embodiment.

It will be observed that there is nothing that can become jammed in the construction of the invention and repair would at most require that the writing instrument be vigorously shaken. It will also be observed that the protracting and retracting action is a positive one in that so long as the lugs 42 clear the bottom of the teeth 51 or the bottom of the deep channels 52, that protraction or retraction will be effected irrespective of the extent to which the button 30 is depressed.

The small number of parts, the ease of producing these parts and the ease of assembling these parts has already been stressed. It is also desired to point out that the construction of the invention employs a conventional cartridge, and when this becomes exhausted, it is easily withdrawn and replaced by a fresh one.

This ease of replacement will be appreciated when it is understood that all that need be done is to remove the lower casing 11 and withdraw the cartridge unit from the upper casing. The new cartridge is then slid into the upper casing, the spring 24 is removed from the old cartridge and placed on the fresh one and the lower casing

11 is screwed back onto the holder 12. When these simple steps are completed and without any precautions, the cartridge is replaced and the protract-retract mechanism is ready for operation. This is a decided advantage over prior constructions employing a continuous cam which normally required that the cartridge unit be specially constructed or fixed to one of the operating mechanisms so that replacement of the cartridge required the availability of a special cartridge, the unnecessary supply of an operating part which was not defective and the application of special skill.

The present invention accordingly provides a writing instrument in which means are provided for protracting and retracting the writing point, said means being actuated by a push member or button a portion of which projects through the rear end of the barrel. The protracting and retracting mechanism includes a continuous cam having longitudinally extending channels separated by a plurality of teeth and a rotatable member mounted beneath the push member for reciprocation thereby. The rotatable member carries at least one outwardly extending lug which slides in the channels and engages the teeth of the continuous cam, the push member and the teeth of the continuous cam contacting only the upper end of the lugs to rotatably bias the rotatable member.

More particularly, the push member is slidably mounted in the barrel in non-rotatable fashion with respect thereto and the push member is provided with downwardly inclined teeth at the lower end thereof and the continuous cam is employed in the form of an internal gear which is preferably formed integral with the upper casing. Also, in accordance with the invention, the rotating member is nested within the push member and both of these members are nested within the internal gear formed by the continuous cam. Also, the invention is particularly adapted for the protracting and retracting of a cartridge unit and enables the simple replacement thereof when the cartridge unit has become exhausted, construction of the pen assembly and replacement of the cartridge unit being facilitated by employing a barrel comprising an upper casing, an intermediate holder and a lower holder with the cartridge unit extending through the lower casing and the intermediate holder and projecting into the upper casing.

The invention includes as a feature thereof the provision of an upper casing formed from a single piece of material as a simple injection molded part in which the internal gear formed by the continuous cam is integrally molded in the interior of the casing.

The present invention resides, not only in the construction of parts as herein set forth, but also in certain individual elements thereof including the upper casing the interior of which is provided with a continuous cam which comprises spaced longitudinally extending deep channels separated by a plurality of teeth with longitudinally extending shallow channels positioned intermediate each of said deep channels. The invention also comprises a push button mechanism and also a rotatable lug member, as hereindescribed and claimed.

While the present invention has been disclosed in connection with the protracting and retracting of a ball point writing instrument, it is applicable to other kinds of writing instruments including those provided with a writing nib or pen point and those which employ a pencil or similar writing medium.

In accordance with the present invention, the spring 24 is the only spring employed, this being in contra-distinction to many writing instrument prior constructions where two springs are employed. The spring of the present invention is desirably in the lower portion of the holder or barrel.

The operating mechanism of the present structure relies upon only three operating parts, namely, the spur gear 30, the rotating lug 40, and the internal gear 50, and these parts are uniquely constructed.

It is desired to point out that the injection molding of the operating parts of the herein set forth retract-protract mechanism from plastic materials insures that these parts are produced with smooth surfaces so desirable for proper functioning of said parts, and moreover, these operating parts can be produced within a close tolerance which is highly advantageous. Any plastic material may be used which will produce an operating part having the proper hardness and smoothness, including the acrylic plastics produced from acrylate and methacrylate resins. The parts produced from acrylic resins are characterized by smoothness of surface and rigidity. Some of the resins are marketed under the trademark "Lucite."

Polyethylene plastics may also be used to produce the operating parts of the present invention, the polyethylene plastics being easy to process by injection molding.

The operating parts of the herein set forth structure may be molded from polystyrenes, said parts being characterized by close tolerances. A modified form of polystyrene which may be used for the operating parts of the present invention is that known as "Kralastic" which is a trademark identifying the polystyrene merchandized by the Naugatuck Chemical Division of the United States Rubber Company, Naugatuck, Conn.

Desirably the operating parts of the present invention are made from cellulose acetate butyrate molding compositions. These compositions comprise a major portion of cellulose acetate butyrate together with plasticizers therefor. Molding compositions of cellulose acetate butyrate lend themselves well to fabrication of the operating parts of the present construction by injection molding, extrusion or compression molding.

Nylon may be used for the operating parts of the present invention. Nylon may be defined as a thermoplastic long-chain super polyamide produced by polymerization from the basic raw materials such as benzene, air and water and characterized by molecular orientation along the long axis of cold-drawing. The polymeric amides merchandized under the trademark "Nylon" are unique in that they have good flow properties and, therefore, may be easily molded by either injection or compression molding or the equivalent thereof.

I claim:

1. In a protract-retract mechanism comprising a tubular casing, a push member slidably and non-rotatably mounted in said casing for movement along the longitudinal axis of said casing, a rotatable member mounted in said casing for movement along said axis between a first axial position and a second axial position and for rotation through at least 360° about said axis, spring means urging said rotatable member toward the push member, said rotatable member and the interior of said casing being formed with coacting members comprising at least one lug element and at least one cam element, there being a plurality of at least one of said elements, each of said elements of which there are a plurality successively coacting with the other of said elements, said cam element comprising a longitudinally extending channel, two circumferentially spaced teeth offset from said channel, and a stop surface between said teeth at a position offset from said channel, said channel extending longitudinally beyond said stop surface, said lug element extending into and being slidable in said channel and engageable with the teeth and stop surface, said rotatable member being in one of said axial positions when a lug element extends into a channel at a position longitudinally beyond said stop surface and in the other of said axial positions when a lug element engages a stop surface, said push member being provided with at least one tooth directed toward said rotatable member, said rotatable member being reciprocable with said push member and a tooth of said push member engaging the rotatable member when the push member is being depressed with said spring means forcing the rotatable member against the tooth of the push member, at least one of the engaging surfaces of the tooth of the push member and the rotatable member being in-

clined so that the force of engagement between the tooth of said push member and the engaging surface of the rotatable member caused by said spring means rotatably biases said rotatable member in one rotational direction about said axis when said push member is depressed, depression of the push member removing a lug element from within a channel and rotating said rotatable member to position a lug opposite one of said teeth of a cam element, said spring means forcing said opposed lug element and cam element tooth into engagement, at least one of the engaging surfaces of said opposed lug element and cam element tooth being so inclined that the force of engagement between said opposed lug element and cam element tooth rotatably biases said rotatable member in said rotational direction; and means adapted to exert an axial force against said push member to axially move said push member, when said push member is released, in a direction opposite the direction in which the cam element tooth thereon faces so that when said push member is released, the force of engagement between said opposed lug element and tooth caused by said spring means rotates said rotatable member until a lug element engages a stop surface, said push member moving to an operative position so that upon a subsequent depression of said push member, a tooth of the push member engages the rotatable member to remove the lug element from engagement with the stop surface and to rotate the rotatable member in said rotational direction to position a lug element opposite another of said teeth of a cam element whereby when said push member is again released, the force of engagement between the latter opposed lug element and cam element tooth caused by said spring means rotates said rotatable member in said rotational direction until a lug element enters and slides longitudinally of a channel beyond a stop surface, said push member moving to the operative position for a repetition of the cycle; the improvement wherein said means adapted to exert an axial force against said push member to axially move said push member, when said push member is released, comprises means for translating said rotatable bias of said rotatable member caused by the force of engagement between said opposed lug element and cam element tooth into an axial force against said push member to move said push member to the operative position when said push member is released.

2. A protract-retract mechanism according to claim 1, wherein said last-named rotatable bias urges a surface of the rotatable member into engagement with a surface of a tooth of the push member, at least one of said last named engaging surfaces being inclined relative to said longitudinal axis so that the force of engagement between said surfaces translates said rotatable bias into an axial force against said push member, said inclined surfaces comprising said means for translating said rotatable bias.

3. A protract-retract mechanism according to claim 2, wherein said inclined surface comprising said means for translating said rotatable bias is a surface on a tooth of said push member.

4. A protract-retract mechanism according to claim 2, wherein each cam element is fixed to said casing and each lug element is on said rotatable member.

5. A protract-retract mechanism according to claim 4 wherein a tooth of the push member engages with and acts on a lug element of the rotatable member to rotatably bias the rotatable member in said rotational direction when said push member is depressed.

6. A protract-retract mechanism according to claim 5 in combination with a writing instrument, said writing instrument including a pen unit slidably mounted in said casing for movement along the longitudinal axis thereof and having a writing point at its forward end adapted to be protracted and retracted through the forward end of the casing, the axial position of the writing point being determined by the axial position of the rotatable member, said writing point being in the protracted position when said rotatable member is in one of its axial positions and in the retracted position when said rotatable member is in the other of its axial positions.

7. In a protract-retract mechanism comprising a tubular casing, a push member slidably and non-rotatably mounted in said casing for movement along the longitudinal axis of said casing, a rotatable member mounted in said casing for movement along said axis between a first axial position and a second axial position and for rotation through at least 360° about said axis, spring means urging said rotatable member toward the push member, said rotatable member and the interior of said casing being formed with coacting members comprising at least one lug element and at least one cam element, there being a plurality of at least one of said elements, each of said elements of which there are a plurality successively coacting with the other of said elements, said cam element comprising a longitudinally extending channel, two circumferentially spaced teeth offset from said channel, and a stop surface between said teeth at a position offset from said channel, said channel extending longitudinally beyond said stop surface, said lug element extending into and being slidable in said channel and engageable with the teeth and stop surface, said rotatable member being in one of said axial positions when a lug element extends into a channel at a position longitudinally beyond said stop surface and in the other of said axial positions when a lug element engages a stop surface, said push member being provided with at least one tooth directed toward said rotatable member, said rotatable member being reciprocable with said push member and a tooth of said push member engaging the rotatable member when the push member is being depressed with said spring means forcing the rotatable member against the tooth of the push member, at least one of the engaging surfaces of the tooth of the push member and the rotatable member being inclined so that the force of engagement between the tooth of said push member and the engaging surface of the rotatable member caused by said spring means rotatably biases said rotatable member in one rotational direction about said axis when said push member is depressed, depression of the push member removing a lug element from within a channel and rotating said rotatable member to position a lug opposite one of said teeth of a cam element, said spring means forcing said opposed lug element and cam element tooth into engagement, at least one of the engaging surfaces of said opposed lug element and cam element tooth being so inclined that the force of engagement between said opposed lug element and cam element tooth rotatably biases said rotatable member in said rotational direction; and means adapted to exert an axial force against said push member to axially move said push member, when said push member is released, in a direction opposite the direction in which the tooth thereon faces so that when said push member is released, the force of engagement between said opposed lug element and cam element tooth caused by said spring means rotates said rotatable member until a lug element engages a stop surface, said push member moving to an operative position so that upon a subsequent depression of said push member, a tooth of the push member engages the rotatable member to remove the lug element from engagement with the stop surface and to rotate the rotatable member in said rotational direction to position a lug element opposite another of said teeth of a cam element whereby when said push member is again released, the force of engagement between the latter opposed lug element and cam element tooth caused by said spring means rotates said rotatable member in said rotational direction until a lug element enters and slides longitudinally of a channel beyond a stop surface, said push member moving to the operative position for a repetition of the cycle; the improvement wherein said lug is on said rotatable member and an internal gear is fixed to the interior of said casing, each cam element forming part of said internal gear, said internal gear having a longitudinally extending portion between said teeth of a cam element, said

longitudinally extending portion extending longitudinally to said stop surface, the end of said longitudinally extending portion adjacent said stop surface and each lug element being so dimensioned that when a lug element is in axial alignment with said longitudinally extending portion, said end of said longitudinally extending portion will prevent axial movement of said lug element past said end toward the other end of said longitudinally extending portion, said push member being provided with at least one outwardly extending lug in axial alignment with said longitudinally extending portion, each outwardly extending lug on said push member and said first named end of said longitudinally extending portion being so dimensioned that said push member lug can move axially past said end toward the other end of said longitudinally extending portion, each push member lug being slidable in the channel of each cam element.

8. A protract-retract mechanism according to claim 7, wherein each cam element channel is radially deep and whereby said longitudinally extending portion is a radially shallow channel so that each lug element of said rotatable member cannot fit within said shallow channel and the push member lug is slidable in said shallow channel.

9. A protract-retract mechanism according to claim 8, wherein there are a plurality of circumferentially spaced outwardly extending lugs on said push member, one of said push member lugs being positioned in a shallow channel and another of said push member lugs being positioned in a deep channel.

10. A protract-retract mechanism according to claim 9, wherein there are a plurality of push member teeth, said push member lugs defining said push member teeth, said push member teeth acting on the lug elements of the rotatable member to rotatably bias the rotatable member when said push member is depressed.

11. A protract-retract mechanism according to claim 10, wherein said internal gear comprises a plurality of cam elements and there is a shallow channel between the teeth of each cam element and wherein the rotatable member is provided with one outwardly extending lug element for each deep channel and said push member is provided with one outwardly extending lug for each deep and shallow channel.

12. A protract-retract mechanism according to claim 11 in combination with a writing instrument, said writing instrument including a pen unit slidably mounted in said casing for movement along the longitudinal axis thereof and having a writing point at its forward end adapted to be protracted and retracted through the forward end of the casing, the axial position of the writing point being determined by the axial position of the rotatable member, said writing point being in the protracted position when said rotatable member is in one of its axial positions and in the retracted position when said rotatable member is in the other of its axial positions.

13. The combination according to claim 12, wherein said means adapted to exert an axial force against said push member to axially move said push member, when said push member is released, comprises means for translating said rotatable bias of said rotatable member caused by the force of engagement between said opposed lug element and cam element tooth into an axial force against said push member to move said push member to the operative position when said push member is released.

14. The combination according to claim 13, wherein said spring means is constituted by a single spring and said spring is the sole spring in the protract-retract mechanism.

15. A push button for a protract-retract mechanism comprising a cylindrical push button provided at its lower end with a plurality of circumferentially spaced-apart outwardly extending lugs, the lower ends of each lug constituting a downwardly directed tooth, the lower surfaces of each tooth being inclined toward each other and toward the axis of the push button so that said tooth tapers to a point which is generally centrally positioned with respect to said lug.

16. A cam member for a protract-retract mechanism comprising an open ended tubular member, said tubular member being provided with an internal gear fixed to the interior thereof, said internal gear including a cam comprising circumferentially spaced longitudinally extending radially deep channels separated by pairs of circumferentially spaced teeth inclined toward one end of said member, said teeth having therebetween a stop surface at a position offset from said deep channels, said internal gear including a longitudinally extending radially shallow channel intermediate said deep channels and extending toward said one end of said tubular member to said stop surface.

17. For a protract-retract mechanism, an open ended tubular member having an internal gear fixed to the interior thereof, said internal gear comprising a cam having circumferentially spaced longitudinally extending radially deep channels separated by pairs of circumferentially spaced teeth inclined toward one end of said tubular member, each pair of teeth having therebetween a stop surface at a position offset from said channels, said internal gear including a longitudinally extending radially shallow channel between the teeth of each pair and extending toward said one end of said tubular member to said stop surface, a push member slidably and nonrotatably mounted in said internal gear for movement along the axis thereof, a rotatable member mounted in said internal gear for movement along said axis between a first axial position and a second axial position and for rotation about said axis, said rotatable member having thereon at least one outwardly extending lug, each lug being slidable in said deep channels and engageable with said teeth and each stop surface and being so dimensioned that it is not slidable in said shallow channel, said push member having a plurality of circumferentially spaced outwardly extending lugs defining teeth directed toward and engageable with each lug of said rotatable member, said push member lugs being so dimensioned that they are slidable in said deep and shallow channels, one of said push member lugs being positioned in a deep channel and another of said push member lugs being positioned in a shallow channel.

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