

Project 1: Write a Technical Description

Topic: Retractable Ballpoint Pen

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1 Introduction

The topic of this technical description is retractable ballpoint pens. The purpose is to provide the reader with a complete description of what a retractable ballpoint pen is and how it works. A definition and brief history is provided, along with a thorough description of the parts: two main components and ten sub-components. These parts work in conjunction to complete two processes vital to the operation of a retractable ballpoint pen. The workings of these processes are also explained in detail.

1.1 General Description and Definition

Retractable ballpoint pens are a type of ballpoint pen. A ballpoint pen is a writing instrument which uses a small metal ball to distribute ink onto a surface (HowStuffWorks 2017). Figure 1 provides a close-up of the ball contained in the writing point of a ballpoint pen. Ballpoint pens are the most popular type of pen in the world and are frequently referred to as simply “pens”, although there are other pen types (McGoogan 2016).

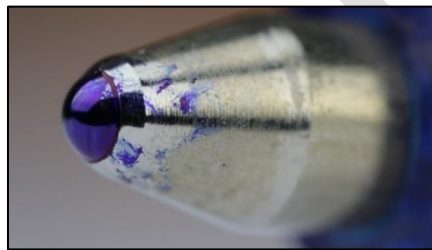


Figure 1: The Ball of a Ballpoint Pen

(Google 2017a)

The word “retractable” refers to the retractable ball point pen’s ability to withdraw or extend the writing tip of the pen into a protective casing. This protects the ink from drying out by limiting air exposure. Retractable ballpoint pens are also known as “click” or “clicky” pens. They can come in many different colours, shapes and sizes, although the main components stay the same. Some examples of retractable ballpoint pen designs are shown in Figure 2.

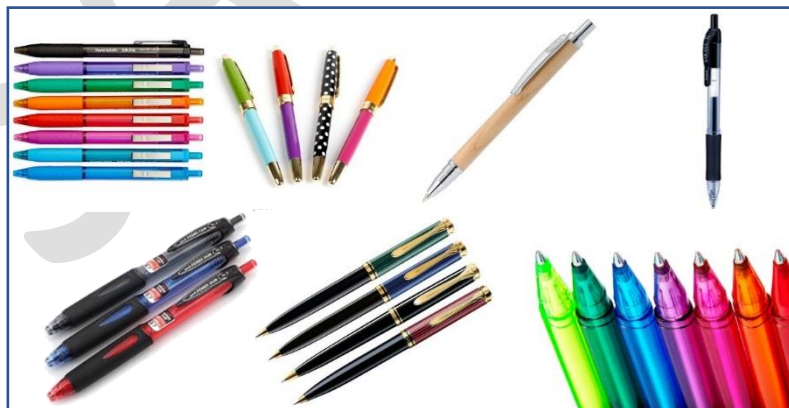


Figure 2: Examples of Retractable Ballpoint Pens

(Google 2017b)

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1.2 History

Ballpoint pens are one of the newer innovations in writing technology, and were invented as a solution to problems encountered with earlier types of pens. Quill, fountain and steel-nib pens all have been around for much longer, but these models had no way of evenly dispensing ink, resulting in blots when writing, and could not be used at high altitudes (Gale Research Inc. 1996). The ballpoint pen and its fast-drying ink were invented in 1938, just before the start of World War II (McGoogan 2016). The English Royal Air Force was the first major buyer and purchased the pens because they could be used during aircraft flights, unlike other models (McGoogan 2016). After World War II the pens were sold commercially and have become the mainstay of the industry.

The first ballpoint pens with retractable points were invented around 1950, although there is some debate as to which company released the first one (Cosmopolis 2002). Today, retractable ballpoint pens are very popular.

2 Technical Description

Retractable ballpoint pens are more complex than meets the eye. They have two main components and up to eight separate parts. These parts all work in conjunction to run two processes critical to a working pen. Section 2.1 defines and describes the individual parts found in a retractable ballpoint pen, while Section 2.2 explains how they work with one another to make a successful writing tool.

2.1 Retractable Ballpoint Pen Components

Retractable ballpoint pens have two main components: the point and the body. Between them, there are ten standard parts which all work together to create this reliable writing instrument. Table A provides a reference list of these parts and Figure 3 identifies where they are located. A description of each part is provided below.

Table A: Parts of a Retractable Ball Point Pen

Component	Sub-Components
POINT	1. Ball
	2. Ink Tube
BODY	3. Front Spring
	4. Refill
	5. Casing
	6. Stop Member
	7. Cam
	8. Plunger
	9. Back Spring
	10. Clip

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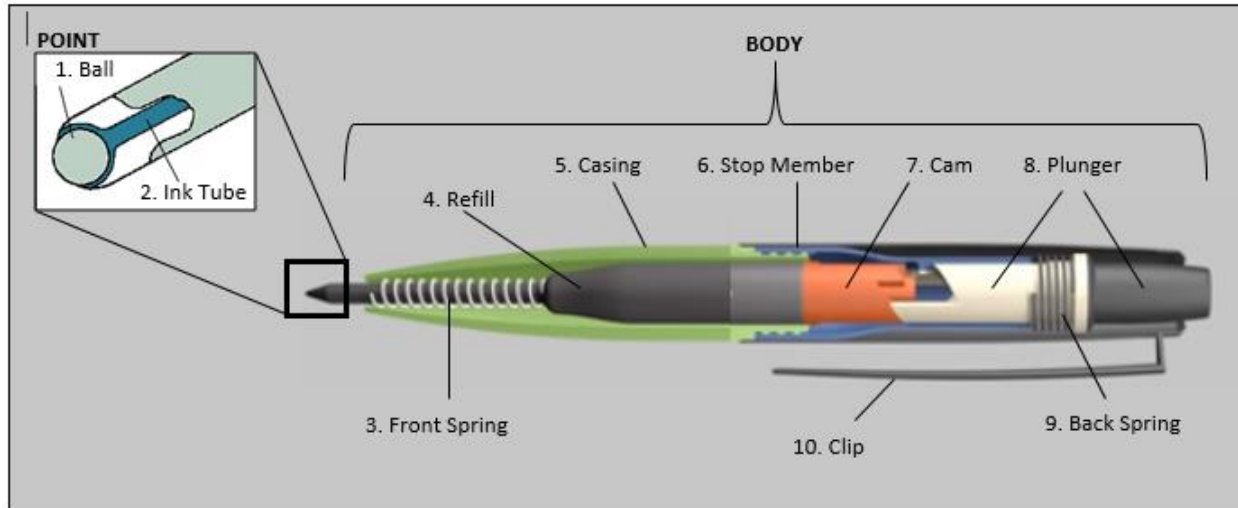


Figure 3: Cross-section of a Retractable Ballpoint Pen

(Encyclopædia Britannica, Inc. 2017)

(The Kid Should See This 2017)

Component: Point

The point is the end of the pen used for writing. It is comprised of the ball and ink tube, described below.

Sub-Component 1: Ball

The ball controls ink flow and provides a seal so ink is not exposed to air when the pen is not in use. This prevents the ink from drying out. On the surface of the ball, there are over 50,000 tiny pits, which serve to transport the ink and to grip onto surfaces (HowStuffWorks 2017). The ball is typically made from tungsten carbide, a metal which is very resistant to deformation, but can also be steel or brass (HowStuffWorks 2017).

Sub-Component 2: Ink Tube

The ink tube is a cylinder which holds the ink, preventing it from spilling or drying out. The ink tube is made of plastic (HowStuffWorks 2017).

Component: Body

The body consists of eight sub-components, which play a vital role in the operation of a ballpoint pen, as described below.

Sub-Component 3: Front Spring

The front spring pushes the refill, cam and plunger upwards, forcing these parts to stay in position. It works in conjunction with the back spring to hold all the interior parts, allowing them to move properly without falling out of place. This part can be made of brass, aluminum or stainless steel (Advameg, Inc. 2017).

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Sub-Component 4: Refill

The refill acts as a reservoir for the ink. Additional ink is stored here, enabling ballpoint pens to last much longer than other types of pens before requiring a manual refill (HowStuffWorks 2017). The refill is made of plastic.

Sub-Component 5: Casing

The casing is the exterior of the ballpoint pen. It houses all the other parts and protects them from outside interference. It also contributes to the aesthetic of the pen and can be made from a variety of materials, including plastic, metal, precious metals and even wood (Advameg, Inc. 2017).

Sub-Component 6: Stop Member

The stop members are attached to the casing and do not move. There are two stop members, positioned opposite to each other. They play a role in the extending and withdrawing of the point. In the extended position, the stop members are fitted to position themselves between the plunger and the cam. In the withdrawn position, the stop members slot into the cam to create a compact interior pen length. They are commonly made from plastic, but could also be brass, aluminum or stainless steel (Advameg, Inc. 2017).

Sub-Component 7: Cam

The cam rotates within the casing of the pen when the plunger is pushed down. It is specially cut to alternate between having slotted cut outs and having no slots. It plays an important role in extending and withdrawing the point. It is commonly made from plastic, but could also be brass, aluminum or stainless steel (Advameg, Inc. 2017).

Sub-Component 8: Plunger

The plunger controls whether the point of the pen is outside of the casing, where it can contact the writing surface, or inside the casing, where it is stored safely (HowStuffWorks 2017). This extending and withdrawing process is initiated when the user presses down on the plunger. It is commonly made from plastic, brass, aluminum or stainless steel (Advameg, Inc. 2017).

Sub-Component 9: Back Spring

The back spring pushes the refill, cam and plunger downwards, forcing these parts to stay in position. It works in conjunction with the front spring to hold all the interior parts, allowing them to move properly without falling out of place. This part can be made of brass, aluminum or stainless steel (Advameg, Inc. 2017).

Sub-Component 10: Clip

The clip is an optional sub-component. The purpose is to provide the user with the ability to attach the pen to other materials for storage, such as fastening the pen to a pocket or binder. It is commonly made from plastic, brass, aluminum or stainless steel (Advameg, Inc. 2017).

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2.1 How Ballpoint Pens Work

There are two processes at work when operating a ballpoint pen. The first takes place in the point of the pen and concerns how the ball transfers ink from the ink tube to the writing surface. The second process takes place within the body of the pen and is the act of retracting the point of the pen from the inside to the outside of the casing. Both are described in detail below.

Process 1: Ink Transfer

The process of transferring ink to a writing surface is unique to all ballpoint pens (not just retractable ones). Ink is stored in the ink tube, which is stoppered by the ball. When the ball is rolled against a writing surface, the following events occur:

1. The tiny pits on the exterior of the ball fill with ink from the ink tube
2. The ball rotates and the ink-filled pits meet the writing surface
3. Gravity and the friction of the ball against the writing surface cause the ink to leave the pits and stay on the writing surface
4. The ball continues rotating, so that ink is constantly being picked up from the ink tube and depositing on the writing surface

Figure 3 provides insight into how this process works.

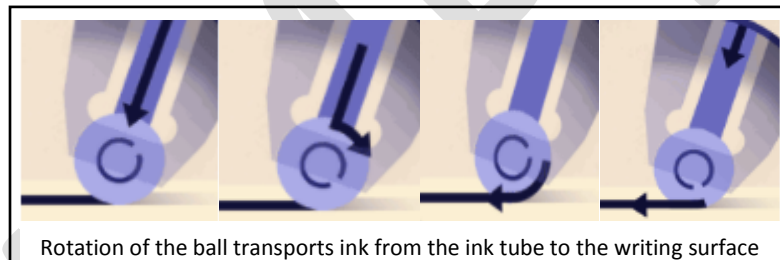


Figure 4: Ink Transfer Process

(Google 2016)

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Process 2: Extending and Withdrawing the Point

Only retractable pens can withdraw and extend the point of the pen into the exterior casing. This process keeps the point from being exposed to air, which helps prevent it from drying out. The added benefit of this process is that there is no contact of the ball onto any accidental surfaces, so ink cannot be transferred until the user extends the point outside of the casing. For example, if the pen was in a pocket and the point was withdrawn, the ball can not contact any fabric and ink would not be released.

The difference between the withdrawn and extended positions of the pen depends on the placement of the cam relative to the stop members. In the withdrawn position, the stop members are nestled into slots on the outside of the cam, such that the cam and stop members are against each other and the interior length of the pen is shortened, as shown in Figure 5. In this position, the length of the interior of the pen is shorter than the exterior casing, and thus the point is withdrawn inside of the casing.

In the extended position, the stop members are no longer slotted into the cam, and are instead resting against the top of the cam. This creates a space between the cam and plunger, lengthening the interior of the pen and causing the point to extend out of the casing (Figure 5).

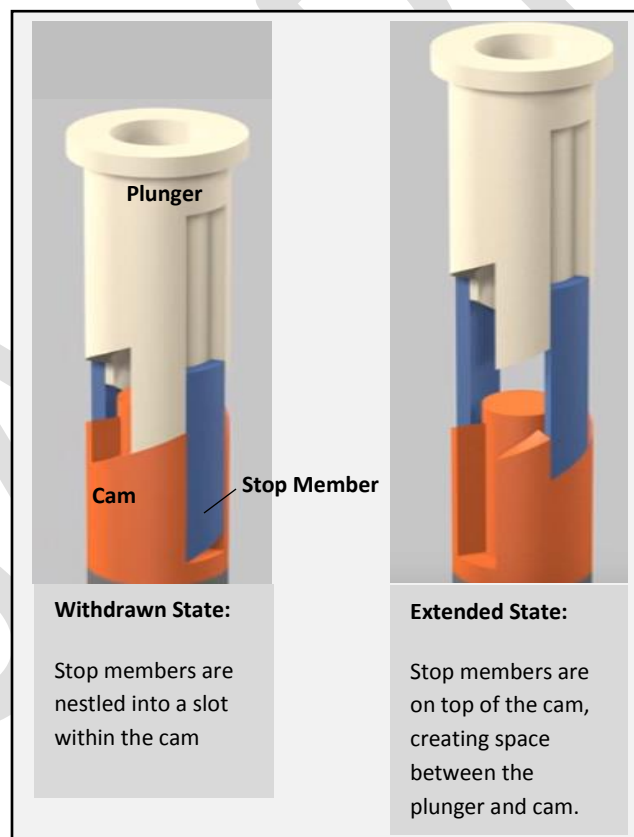


Figure 5: Withdrawn and Extended Positions

(The Kid Should See This 2017)

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The change in position takes place through a reaction initiated by the user. When the user presses down on the plunger, the pressure causes the cam to rotate 45 degrees, or a quarter of the way around, changing its position in relation to the stop members. The cam is designed specially for this purpose: it is cut so that when it rotates, the stop member position alternates between being against the slot they can slide into (withdrawn position) and being against the top of the cam (extended position). With each rotation of the cam, the stop members are newly positioned, thus alternating from withdrawn and extended positions each time the plunger is pressed down.

The top and bottom springs play an important role in this process: they provide the tension which holds the plunger, cam and stop members against each other. Without the springs on either end, these pieces would not have the motivation to press against each other and the rotation of the cam would not take place.

3 Summary

In summary, retractable ballpoint pens are a writing instrument which use a small metal ball to distribute ink onto a surface and can withdraw or extend the writing tip of the pen into a protective casing. Since the invention of the ballpoint pen just before World War II, they have become most popular type of pen in the world. Retractable ballpoint pens appeared on the market shortly after and are also very popular.

Retractable ballpoint pens are comprised of two main components, the point and the body. The point has two sub-components: the ball and the ink tube. The body consists of eight sub-components: front spring, refill, casing, stop member, cam, plunger, back spring and clip.

These parts work together to complete two processes: ink transfer and extending/withdrawing the point. Ink transfer is the process in which the ball of the pen rotates along a writing surface, picking up ink from the ink tube and distributing it onto the surface. Extending and withdrawing the point of the pen is an intricate process in which the user of the pen presses down on the plunger, causing rotation of the cam against the plunger. The change in cam position affects the position of the stop members, which can either:

- a. Nestle into a slot in the cam such that the cam and plunger are pushed against each other, shortening the interior length of the pen and causing the point to withdraw into the casing; or
- b. Create a space between the cam and plunger, lengthening the interior of the pen and causing the point to extend out of the casing.

This process minimizes exposure of the ink to air and prevents leaking.

4 References

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