

## **Fundamental Concepts on the Main Types of Airstream Mechanisms in the Production of the English Language Sounds**

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**Abstract:** *The first and fundamental approach to classify the sounds according to the phonetic characteristics is by the source of the airflow. The languages of the world use many types of airstream mechanisms to create their sounds, the most known mechanisms are: Pulmonic, Glottalic and velaric airstream mechanisms.*

*In English sound system, for instance, all sounds are created by airstream mechanism made by the expiration of the airflow from the lungs, and this process is known as (Pulmonic Airstream Mechanism).*

*The expression 'airstream mechanism' has several concepts and significations. In modern discussion, airstream mechanisms are understood as airflow production in the larynx area influenced by the vocalic and consonant segment. In general, the respiratory airstream mechanisms are regarded as physiological phenomena.*

**Key words:** *Airstream Mechanism, Pulmonic, Glottalic, Velaric, Egressive, Ingressive.*

### **1. Introduction**

There are different main types of airstream mechanism which are used in generating of the human speech sounds. The most recognized airstream mechanism in all languages is the (Pulmonic egressive mechanism), in this mechanism, the airflow comes from the lungs, and the less popular is the (Pulmonic Ingressive Airstream Mechanism), where the airflow is absorbed in the lungs. The created sounds in this mechanism are known as (Implosives). (**Carr, 2008: 10**).

The airflow comes from the lungs and it is the only source and generator for all the sounds, if the airflow is pushed out it is a pulmonic airstream mechanism, the lungs are similar to sponge and a cavity shaped because of the rib cage and the diaphragm, and when the diaphragm shrinks, it expands the cavity in the lung and in this time the airflow influxes to the lungs.

The cavity in the lung may be expanded with the height of the rib cage. The airflow may be gone out of the lungs with the pulling of the rib cage or by pushing the diaphragm up with the approaching of abdominal muscles. In many languages sound systems, the speech sounds are created with the movements of various types of airflow. (**Ladefoged and Johnson, 2015: 144-145**).

Airstream mechanisms compose a significant subject in phonetics because they describe the flow of energy generated for sounds of the speech. They have been investigated in different languages, the results of which are of substantial concern in general linguistic study. Speech sounds contain consonants and clicks with variations according to the airstream mechanisms may appear in initial, middle, or final positions of words or might not occur in a specific position at all. Moreover, the directions in cross-linguistic analyses of vowel-first languages consider specific phonetic

characteristics can be influenced by the phonation mechanism of the current preceding segment. (Everett et.al., 2023:3).

Airstream mechanisms focus on the airflow patterns required in the generation of speech. As a theoretical construct developed to describe general mechanisms, it does not take into account variants caused by individual differences, speaker characteristics or accidental articulators. In addition to the vocal cord setting for controlling vibrations, the opening and closing of the glottis also impact the vibratory state of the vocal folds and the airflow in and out. These three kinds of airstreams, in combination with the different states of the glottis can make oral and nasal airstreams and then have different influences on the sound. Upper air routes are highly changeable according to the movements of the front, middle and back of the tongue and the reduction of the resonant cavity of the mouth.

## 2. Definitions and Significance of Airstream Mechanism

The three considerable mechanisms are pulmonic (requiring the lung airflow), glottalic (requiring the pharynx airflow) and velaric (requiring the mouth airflow). Any mechanism of these types can make an egressive (moving outward) or an ingressive (moving inward) airstream, that outcome with six main airstreams. In fact, the pulmonic egressive mechanism is the most common airstreams mechanism, and the glottalic egressive and glottalic ingressive mechanisms are also found, the velaric ingressive mechanism takes place in few languages. (Trask, 1996: 15).

The occurring of the phonetic sounds, the airflow must go with articulators, the movable airflow is known as the airstream, it is specified by the airstream mechanism. The anatomical parts whose influence collects the airstream in motion is recognized as the (Initiator), the airstream mechanism can be (Egressive), which means the airflow streaming from the body, or (Ingressive) the airflow flowing inside the body. The airstream mechanisms occur by the variation of the air compression in the vocal system. (Rogers, 2000: 13).

The speech sounds which are used in the languages of the world are generated by the airflow which is pushed up from the lungs in the wind-pipe, when this airflow leaves the body through the mouth or nose this movement of the airflow is known as (Egressive Pulmonic Airstream). Practically, all sounds in English are made with egressive pulmonic airstream mechanism. This mechanism is the mechanism which depends on the lung airflow. Three are different airstream mechanisms which are occurred in some African languages, in these languages the airflow in the mouth not the airflow of the lung in making their sounds, and when the airflow moves up from the glottis, it is regarded as (Egressive Glottalic airstream Mechanism), the generated sound is known as (Ejective), and if the glottis lets the airflow inward, it is (Ingressive Glottalic Airstream Mechanism) and the sound in this case is (Implosive). Furthermore, when the airflow is sucked as an outcome of the movements against the back part of the roof of the mouth, it is regarded as (Ingressive Velaric Airstream Mechanism), and the generated sound in this case is (Click), and any language contains click sounds is recognized as (Click Language). (Skandera and Burleigh, 2005: 11).

## 3. Pulmonic Airstream Mechanism

This airstream mechanism is an essential airstream mechanism in speech production, and the lungs is its initiator. Actually, many languages have the pulmonic airstream mechanism, and the major activity of the lungs is for breathing and the other activity is the speech sounds production. (Rogers, 2000: 253).

Pulmonic airstream mechanism is the popular type of airstream mechanism in the production of human beings' speech sounds. Pulmonic airstream is generated by the movements of the muscles which dominate the flow of air from the lungs to the mouth or nose. In the movement of the airflow goes through the mouth or nose, the sounds are generated and the articulators distinguish the airflow as oral or nasal, because the air is sent to flow out from the lungs and the cavity between the open vocal folds and the mouth.

According to Laver (1994: 162) the respiratory system is the initiator of the pulmonic airstream mechanism and it is supplying the airflow which can be changed because of the respiratory system and articulatory movements. The movements of the respiratory system within speech sounds are

varied from the movements of breathing. With speaking the expiratory stage is stronger than the inspiratory stage. Moreover, the normal breathing mainly uses muscular movements during inspiration and predominantly mechanical and elastic reactionary intensity as the major procedure of expiration.

When the vocal folds open for making a sound, airflow is expelled out under some compression in the voiced or voiceless stage. The sounds are created with the pulmonic airstream mechanism, the place of articulation and the movements of the tongue. In addition, sounds are identified as nasal or oral sounds, or according to velum placement. Pulmonic airstream mechanism is one the different kinds recognized of airstream in the languages of the world.

### 3.1 Egressive Pulmonic Airstream Phonemes

This mechanism is the most significant one for generating sounds, and most sounds in languages of the world are generating by the effect of the airflow that comes to the vocal tract which is expelled from the lungs, this mechanism is recognized as the pulmonic egressive airstream mechanism and the sounds which are produced in this way are called (The Pulmonic Egressive Sounds). In English, the plosive consonants /p, b, t, d, k, g/ are classified as pulmonic egressive sounds.

In the pulmonic egressive airstream mechanism the airflow is changed in the oral cavity to create the sounds of specific languages. Actually, there are central kinds of airflow variations:

- 1- Total stop happens after an abrupt explosion, the result is the stops phonemes.
- 2- Total stop happens after imperceptible explosion, the result is the affricates phonemes.
- 3- Shrinkage or narrowing of the way of the airflow, the result is the fricative phonemes. (**Birjandi and Salmani-Nodousham, 2005: 84**).

With the pulmonic egressive airstream mechanism the airflow is compressed out of the lungs in the diaphragm and the rib cage muscles, the airflow goes out through the mouth or the nose. This mechanism is a fundamental mechanism in all languages. (**Trask, 1999: 6**).

### 3.2 Ingressive Pulmonic Airstream Phonemes

In this mechanism, the inhale air is modified to generate sounds. This mechanism is actually found in a small and exceptional number of languages, which are considered as native languages, these sounds are called (Pulmonic Ingressive Sounds) and they are considerably infrequent sounds.

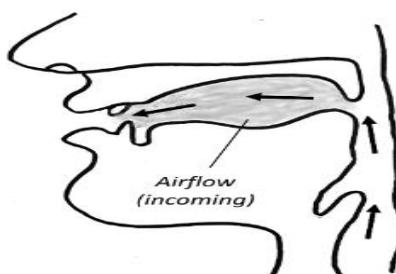


Fig. (1) Egressive Pulmonic Airstream

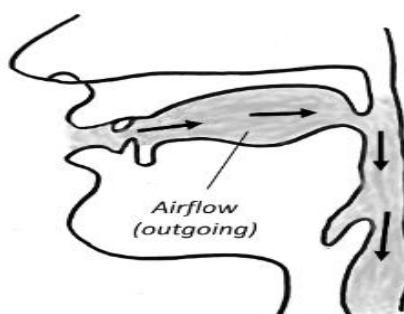


Fig. (2) Ingressive Pulmonic Airstream

#### 4. Glottalic Airstream Mechanism

When the airflow runs out from the lungs, it is still in the larynx because of the occlusion of the glottis, this restricted airflow in the glottis is recognized as a glottal stop airflow. In some specific structures, the English language has a glottal stop sound /ʔ/ in specific controversial utterances, as in: bottle /'bɒt'l/ ['bɒʔl]

the glottal stop is a pulmonic egressive sound, when the airflow comes from the lungs it is stopped. The glottis can be blocked instantly before the generating specific sounds and making restricted sinus of airflow in the vocal tract. In glottalic airstream mechanism, the vocal folds totally blocked and no airflow runs from the lungs and the airflow is blocked and raised to push the airflow up and out an ejective consonant is produced. The airflow is forced into the vocal folds and treated by the speech organs, the glottis is blocked and lowered to make a tiny vacuum in the mouth and an implosive consonant is generated. The lowering glottis plays a role like the down movement of a piston to produce a short verification of airflow in the vocal tract, when the structure is in the mouth is freed, the airflow goes to the mouth.

Glottalic sounds are commonly identified to ejectives and implosives, many opinions also characterize glottal double articulations. In the glottalic airstream mechanism, the air is initially restricted in the superior respiratory passages and is then used to generate a compression variation for sound generation. This compression variation is made by manipulation somewhat more rostrally than is occurred in velaric sounds, namely at the larynx, where there are three possible articulations: the larynx is completely open and creates a glottalic egressive airstream; the larynx is completely closed and makes a glottalic ingressive airstream; and the larynx is reasonably closed, resulting in ejectives in an explosion of glottal escape of airflow as compression is released, and in implosives, the establishment of a negative subglottal pressure. (Sande & Oakley, 2023: 6).

The initiator of the glottalic airstream mechanism is the larynx when it is pulled up by the laryngeal elevator muscles, the phonemes created on the glottalic egressive mechanism, or down by the laryngeal depressor muscles, the phonemes created with the glottalic ingressive mechanism. The glottalic airstream mechanism is the only airstream mechanism required the obstructed glottis with the vocal folds, they close the quantity of airflow in the lungs form airflow in the remnant of the vocal system. In this moment, the human beings are actually controlling their breath. The larynx moves perpendicularly in the pharynx in this type of airstream mechanism, and sometimes it is known as (The Pharyngeal Airstream mechanism). The phonemes created in a glottalic egressive airstream mechanism are known as (Ejectives). Ejectives are generally produced in the vocal system for a short time and either totally or nearly obstructed by the tongue or lips in the same place along its length. (Laver, 1994: 171).

##### 4.1 Ingressive Glottalic Airstream Phonemes

The phonemes created in the glottalic ingressive airstream mechanism are known as (Implosives). In implosives, the larynx is pulled down and any airflow is confined in the larynx and a closure in the up place of the vocal system. The oral stops phonemes look to be created in this type of airstream mechanism in linguistic usage. Implosives contain two types of airstream mechanism, the glottalic ingressive airstream mechanism and pulmonic egressive airstream mechanism. The stops and affricates require occlusion in the upper vocal tract and pulling the larynx down using the infrahyoid muscles. The airflow in the vocal system is unusual and it is decreased with compression. In the production of the stop segment, the airflow is not cognizable. The implosive consonants are commonly voiced, that means the airflow must influx to vocal tract from the lungs at the same moment. (Gick and et.al., 2013: 116).

The implosives sounds are not expressive sounds in the English language, these sounds can be found in our daily life to mime some sounds, i.e., (glug glug) the sound of drinking something, (bok-bok) the sound of chicken. (Rachael-Anne Knight, 2012: 85).

## 4.2 Egressive Glottalic Airstream Phonemes

The glottalic egressive phonemes are also called (Ejectives), in this type of mechanism the airstream needs the larynx to create the glottalic egressive, the larynx is approaching to shape the glottal stop and then producing the oral constriction or stop /t/ at the upper vocal tract, the airflow is extremely compressed and finally producing the oral constriction (Popping Segment). This type of airstream mechanism keeps sufficient airflow to create ejective fricatives, affricates and stops. The major approaching of the larynx is created and using the suprahyoid and pharyngeal elevator muscles. (Gick and et.al., 2013: 117).

All three types of airstream mechanisms have unique aerodynamic characteristics and resultant sound wave shapes, along with fairly distinct physiological attributes. Also, articulations and aerodynamic features of implosive or ejective sounds are distinct from their egressive counterparts because these sound types are actually 'out of the phonetic norm.' When producing sounds sequentially from pulmonic to ejective to implosive, glottis pressure loss is doubled from pulmonic to egressive ejective, doubled again from egressive-to-egressive implosive, doubled a third time from egressive to ingressive ejective, and halved from egressive to ingressive implosive. Either egressive or ingressive pressure loss can be roughly similar to glottal pressure variation in voicing configurations.

With the glottalic egressive phonemes the glottis is locked and the larynx is upward like a compressor pushing the airflow of the larynx out from the mouth. The phonemes are ejectives and they found in limited languages. (Trask, 1999: 6).

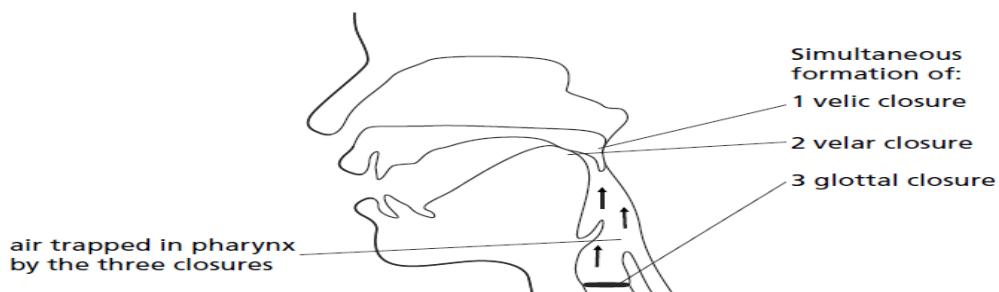


Fig. (3) The glottalic egressive airstream mechanism: Step 1. Adapted from (Ashby, 2011: 71)

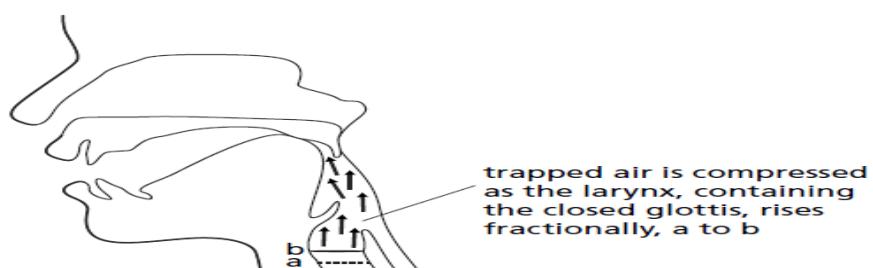


Fig. (4) The glottalic egressive airstream mechanism: Steps 2 and 3. Adapted from (Ashby, 2011: 71)

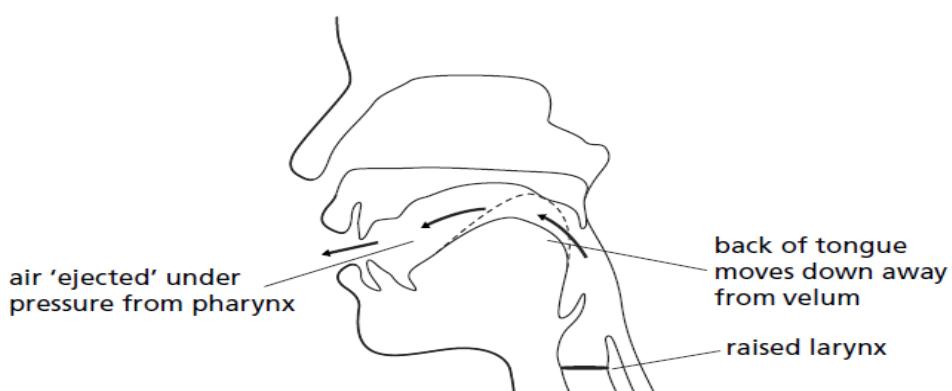


Fig. (5) The glottalic egressive airstream mechanism: Step 4. Adapted from (Ashby, 2011: 72)

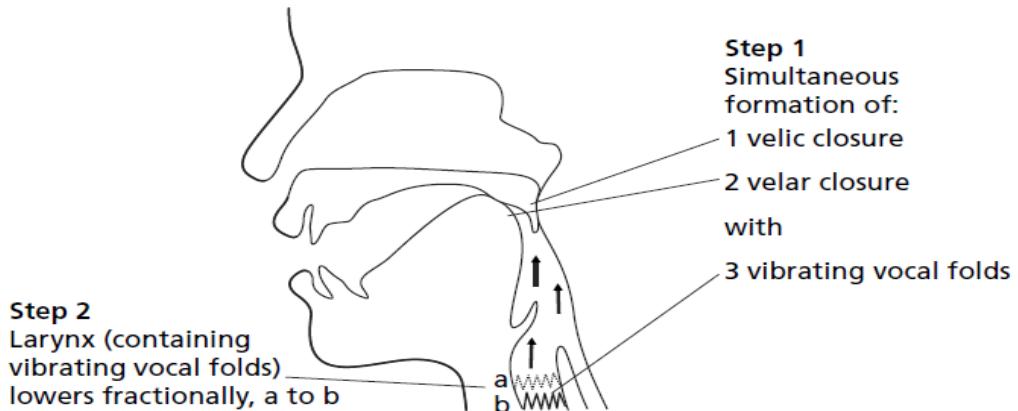


Fig. (6). The glottalic ingressive airstream mechanism: Steps 1 and 2. Adapted from (Ashby, 2011: 74)

## 5. Velaric Airstream Mechanism

The velaric airstream mechanism is distinguished by the application of negative compression made by the tongue moves against the velum. Since velaric airstreams cannot be controlled at the glottis, they cannot be used simultaneously with laryngeal egressive sounds, they are supposed to be "lingual grammatical symbols" (hence they are also called "non-pulmonic" and "lingual implosive"). In addition, the limited number of languages that have them. By moving the tongue upward, the volume between the tongue dorsum and the hard palate decreases, creates negative pressure, and results in an inhaled sound.

The velaric airstream mechanism is also known as (The Oral Airstream mechanism), because all the required activities occur in the mouth and also known as (The Lingual Airstream Mechanism), because the major initiator is the tongue.

### 5.1 Ingressive Velaric Airstream Phonemes

Ingressive velaric phonemes are also known as (Clicks), i.e., the stops and affricates and they are found in the phonological usage in languages. The expression (Clicks) refers to the velaric airstream mechanism which is being used to produce the stop articulation. The clicks phonemes are found in African languages, i.e., Khoisan languages, such as: Bushman and Hottentot, clicks phonemes are also occurred in the Southern languages, such as: Khosa and Zulu, and there are in East African languages which have clicks phonemes i.e., Sandawe and Hadzapi in Tanzania language. (Laver, 1994: 174).

In generating a velaric ingressive airstream mechanism, the back of tongue creates a constant approach to the soft palate and the tip of the tongue is also used to create articulatory approach with the alveolar ridge. This produces a tiny cavity of air which is restricted in the back and front of the tongue. The compressed air in this cavity can be unusual, this occurs by dropping the centre of the tongue or dragging the tip of the tongue back over the roof of the mouth or with the series of these activities. The clicks phonemes are commonly generated with two tongue relations, one kind is generated with articulatory occlusion between the two lips. In this time, the air cavity is distinctly wide and it extends from the velum to the lips. The clicks phonemes require a tiny amount of airflow than the ejectives and implosives have. (Ball and Rahilly, 1999: 27).

This type of airstream mechanism is found in, some types of the African languages, in velaric airstream mechanism there is organized oral vocalization, at the same moment the back of the tongue closes the airflow from the lungs and makes specific space then the airflow in the mouth is weak and unstable, in this moment, the stricture is freed and the airflow runs making a click segment. The English language uses a few velaric sounds for quasi-linguistic gesticulations, for example, a bilabial velaric click as:

- The sound of a kiss (It is a bilabial velaric sound).

- Tisk-Tisk sound (a lateral velaric sound, it is used to move the horse).
- Tut-Tut (It is used to move the animals).

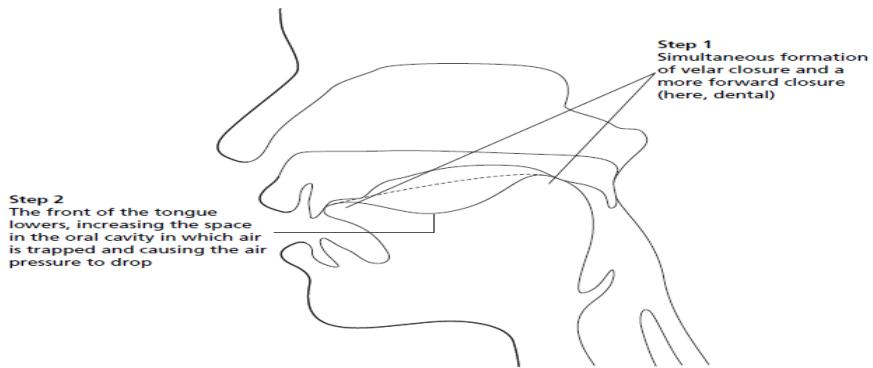


Fig. (7) The velaric ingressive airstream mechanism: Steps 1 and 2. Adapted from (Ashby, 2011: 77)

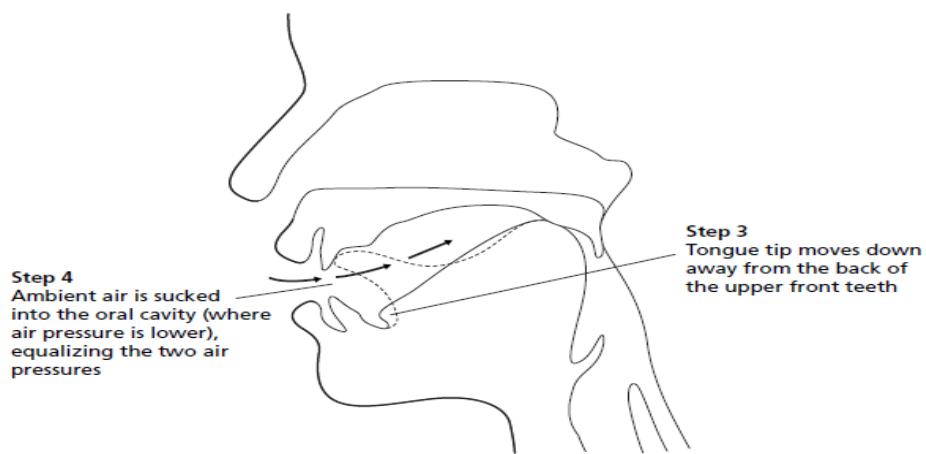


Fig. (8) The velaric ingressive airstream mechanism: Steps 3 and 4. Adapted from (Ashby, 2011: 77)

## 5.2 Egressive Velaric airstream Phonemes

With the velaric egressive phonemes, the back of the tongue is compressed in the velum and another occlusion is created, the body is pushed up, the front occlusion is freed and the airflow in the mouth is going out, the outcome phonemes are called (Reverse Clicks), egressive velaric phonemes are not occurred in any language, and there is no linguistic usage for egressive velaric phonemes (**Laver, 1994: 174 and Trask, 1999: 6**).

## 6. Other Types of Airstream Mechanisms

There are other minor types of airstream mechanisms which can be occurred, and their phonemes do not used in the linguistic usage, such as: Buccal Airstream Mechanism: The expression (Buccal) is commonly used in phonetics and it is relevant to the buccal cavity, and it is sometimes used to refer to the sounds which are occurred in the cheek area. In this type of airstream mechanism, a quantity of little airflow can be trapped in the check and released by the organs of speech. (**Crystal, 2008: 62**).

In this airstream mechanism, the airflow is controlled by the upper jaw and the cheeks, and it is obligatory moving through the opening of the teeth and goes from the mouth, the origin of the airflow is tiny, and because of the airflow origin is from the front of the nasopharynx, the creating of the nasal phonemes with buccal mechanism is very complicated, the buccal airstream mechanism has a great and essential frequency than the laryngeal articulation. (**Gick and et.al., 2013: 107**).

Furthermore, the Oesophageal and Trache-oesophageal Airstream Mechanism, in this type of airstream mechanism, the speech can be understood by the speakers whose larynxes are removed

because of the diseases. Oesophageal airstream mechanism needs the usage of the movable and influential airflow line from the esophagus, and the vibration occurs at the sphincteric pharyngooesophageal connection, then the airstream mechanism is changed by the supraglottal articulators and resonators in natural direction. In this airstream mechanism, the airflow of the lung is not obtainable and useful. (Ball and Rahilly, 1999: 27-29).

## 7. Conclusions

This research investigates the three basic airstream mechanisms, recognized about (150) years ago, and without airstream mechanisms phonetics and linguistics in general would not be considered as a science. This research discusses the three airstream mechanisms and their recognition in human speech, speakers can generate any type of airstream mechanisms by using laryngeal articulation, starting from voiceless and voiced glottal mechanisms through voiceless and voiced nasal mechanisms to the so-called pure and relatively weakly egressive voiceless and voiced, as well as breathy-voiced and creaky-voiced pulmonic mechanisms. Distinguishing such articulatory identity of the human speech organ would not have been possible disregarding its phonetic aspect.

The study of airstream mechanisms is relevant to the active articulators, whose movements result in distinctive speech sounds. Languages across the world depend on three major pulmonic closures: nasal, oral and lateral resonances, and they achieve this variety by altering the airstream mechanisms engaged. Indeed, the engagement of different airstream mechanisms can indicate to the phonemic contrasts for a language. Based on a review of the sound principles of phonological theory, phonetics and articulatory findings, the understanding of the three essential airstream mechanisms is important. The languages of the world can contain the following Airstream mechanisms:

Pulmonic Airstream Mechanic	Egressive
	Ingressive
Glottalic Airstream Mechanism	Egressive
	Ingressive
Velaric Airstream Mechanism	Egressive
	Ingressive

- 1- Pulmonic egressive: It is found in all languages of the human beings.
- 2- Pulmonic ingressive: It is not found at all.
- 3- Velaric egressive: It is not found at all.
- 4- Velaric ingressive: It is found in African Languages, i.e., Zulu.
- 5- Glottalic egressive: It is found in some Nort American languages, i.e., Navajo.
- 6- Glottalic ingressive: It is found in some Indian Languages, i.e., Sindhi.

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