

DIP/TEC+1 C/T/IT  
2021  
ANALOGUE  
ELECTRONICS

Omim Owura

## UNIT OUTLINE

- o Subject definition
  - What is Electronic
  - Analogue Electronics.
- o Materials used in Electrical Engineering.  
Classification.

>

- Good Conductors
  - Poor Conductors
  - Semiconductors
- ④ Semi-conduction Technology.
- Types of Semiconductors.
    - \* Pure Semiconductor
    - \* N-type semiconductor
    - \* P-type semiconductor

## Semi-Conductor devices

- The P-N Junction.
- Application of a diode.
- P-N Junction as a  
diode.

Applications of a diode.

Junction diode as a power  
rectifier.

Power Supply Unit  
Special Diodes.

- \* TRANSISTOR RESISTOR.
- \* FORMATION OF TRANSISTOR.  
    NPN TRANSISTORS,  
    PNP TRANSISTORS.

- Transistor as a switch
- Transistor as a diode.

- ~~Transistor Amplifier~~
- ~~x Decoupling~~ ~~Termination~~ = Biasing.
- Transistor Amplifier Configuration
  - Transistor Amplifier Biasing.
  - Single Stage Amplifier.
  - Two Stage Amplifier.

- + Unipolar Transistor.
- Junction Field Effect Transistor.  
(JFET)
- Metal Oxide Semiconductor Field Effect Transistor.  
(MOSFET).

FET - Amplifiers



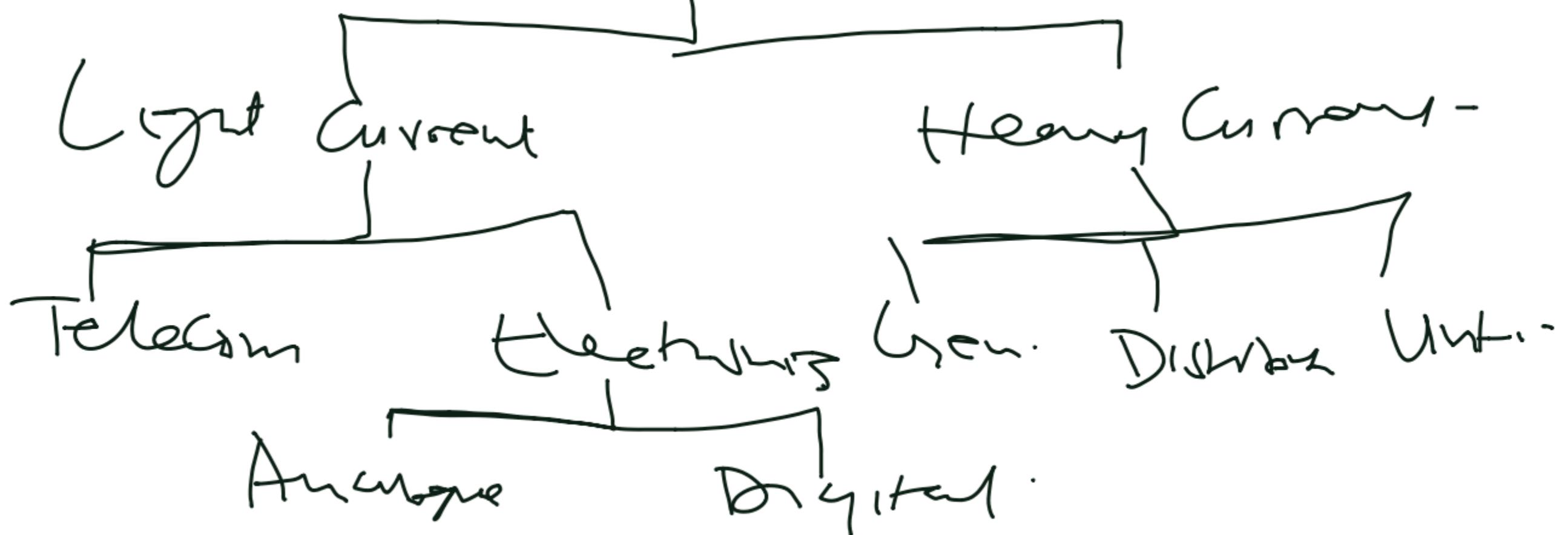
$$\frac{100 - 40}{100} = \text{Pass}$$

~~100 - 40 = 60~~

~~60~~ ~~100~~ Ignorance

# Electronics

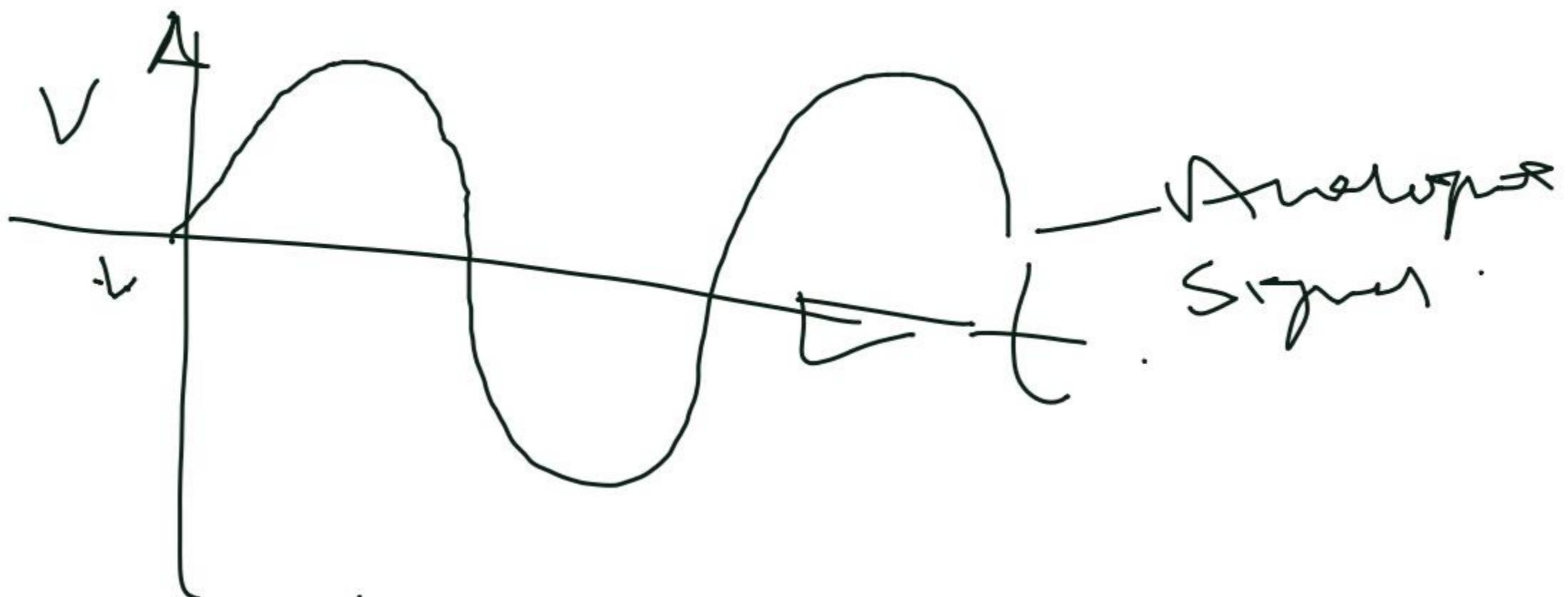
Electrical Eng.



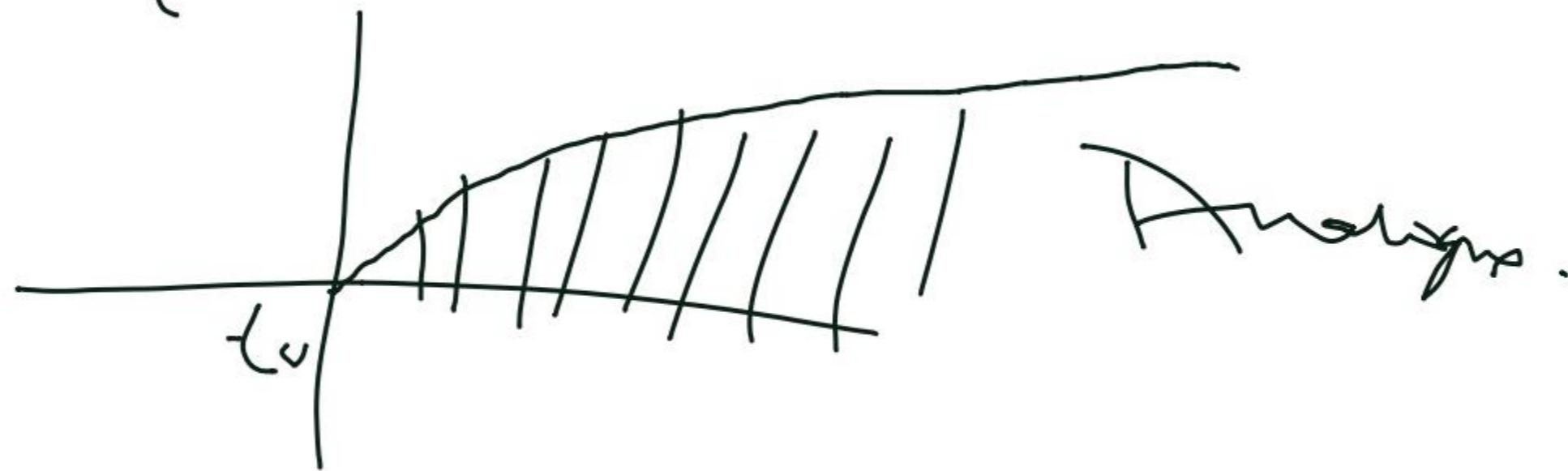
Electrical Engineering  
is the Branch of Technical  
Engineering They deals  
With Small Current,  
the Circuit Subsystems, Components  
System and Subsystems That  
Handle and Process the Small  
Currents.

# Analogue Electronics

This is the Branch of  
the electronic engineering discipline  
which deals with the study and  
application of circuits, components,  
(systems, subsystems and sub-subsystems)  
that handle small electrical  
signals whose amplitude / keep time.



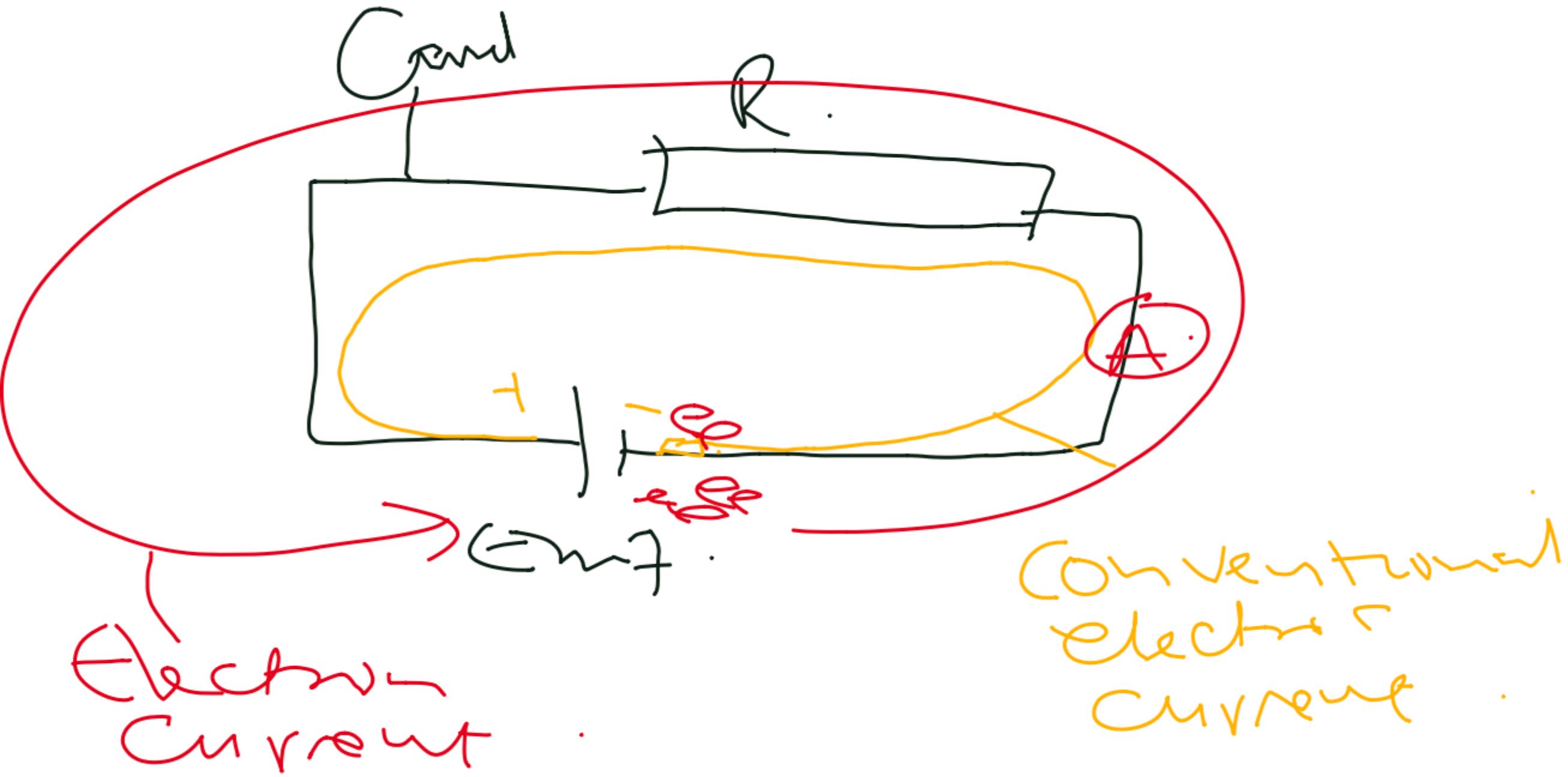
Analogous  
Sign.



Analogous.

## Electric Current

This is the Mass movement of electrons in a good Conductor under the influence of electric pressure.

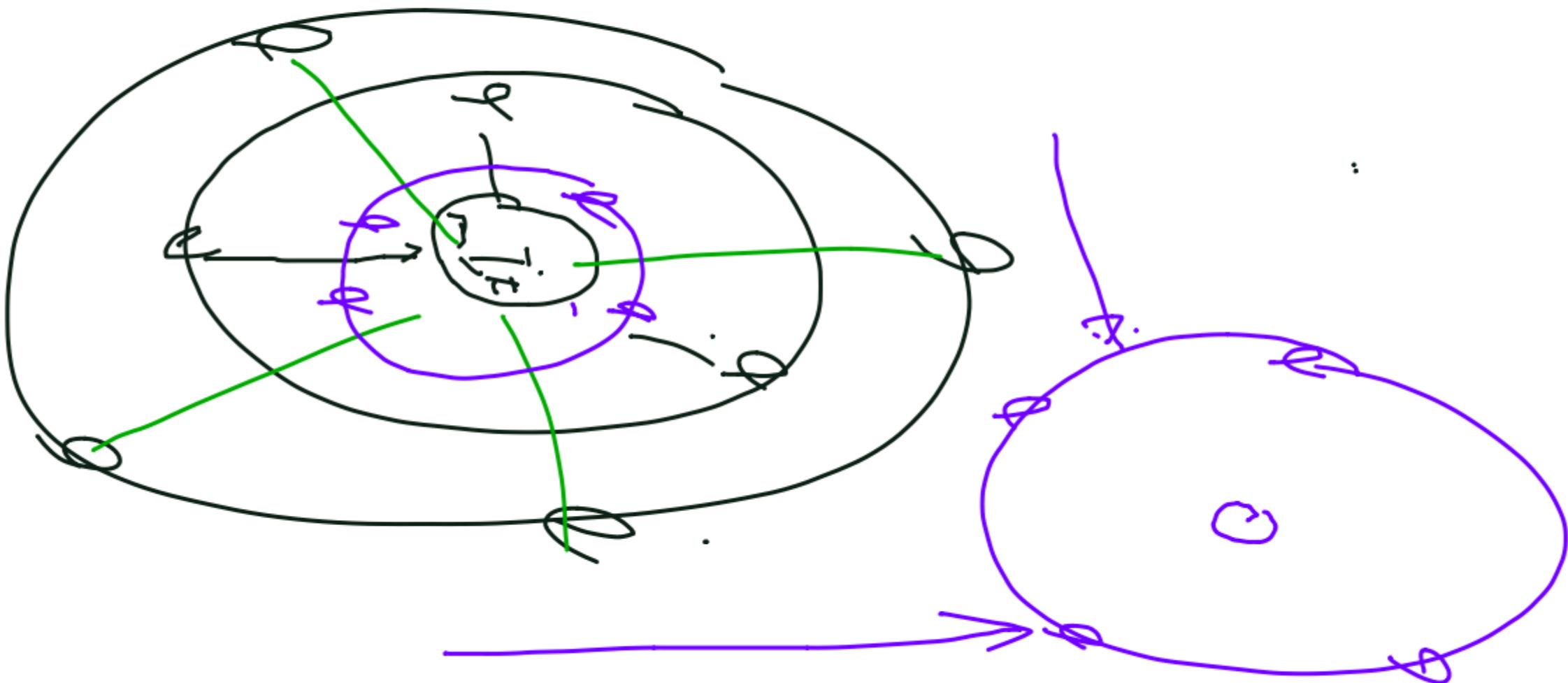


# Electrical Engineering Materials

All the Materials  
May be classified into  
only THREE Categories  
in Electrical Engineering  
More one.

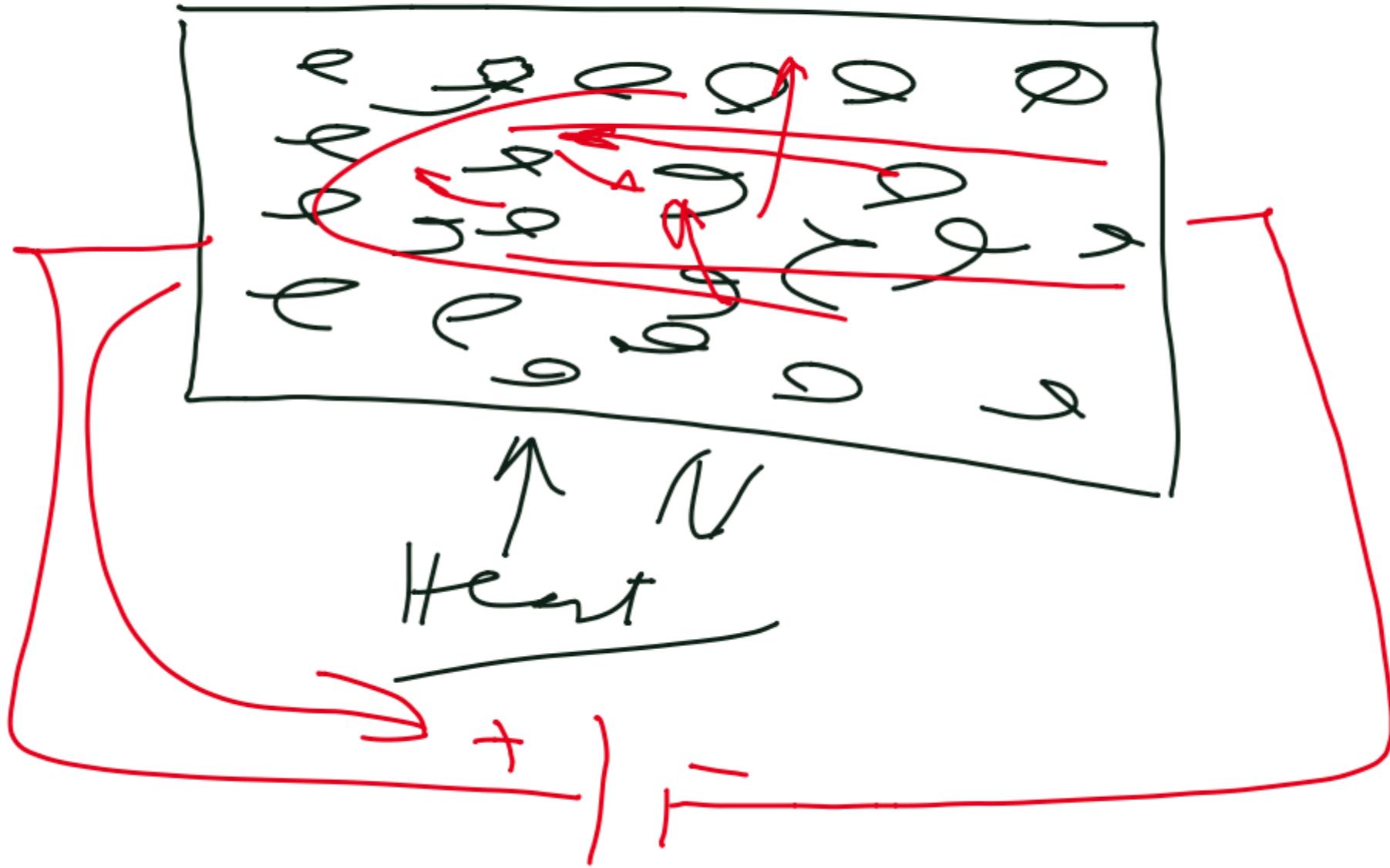
- 1) Good Conductors  
of Electricity.
- 2) Poor Conductors  
of Electricity
- 3) Semi-conductors.

# Good Conductors



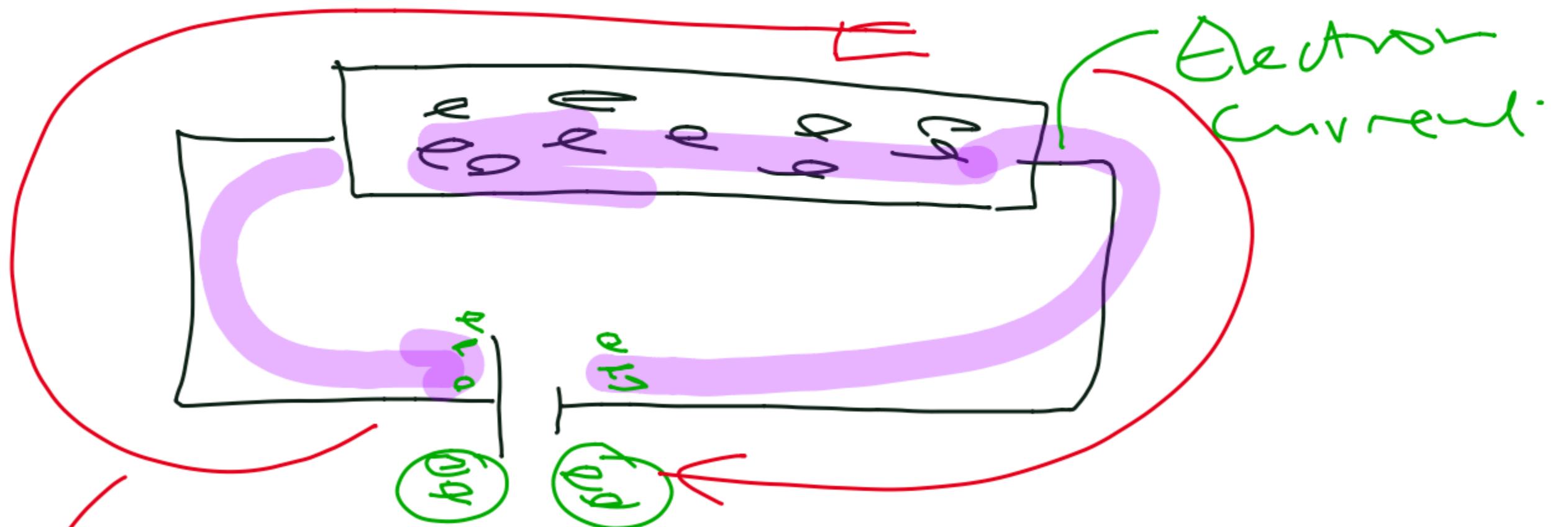
These are Materials  
whose Atomic Structure  
are such that their  
outer most orbit  
is placed too far from  
the centre of the nucleus.  
The attraction of unit-

of the electrons  
or in outer  
orbit to the  
Centre is the result.  
It is said that electrons,  
free and basic (large  
amounts).



The Electrons  
in the material are  
detached from the  
matter atom, and are  
free to wander about  
the material structure.  
Upon the provision of  
electric pressure these electrons

are given the direction  
of motion. This allows  
them to move in one  
direction hence  
constituting the  
Electric current + flow  
from the Positive terminal  
to Energy source (emf) + to  
the Negative terminal + to



Electric Current .

Example of Good Conduktw,

- g the following
- 1) Gold
  - 2) Silver
  - 3) Copper
  - 4) Goldit
  - 5) Tin -
  - 6) Steel
  - Metals

Mercury -  
etc . . .

# Poor Conductors



The Atom &  
Structure of their  
Materials give such that  
the outer orbit is so  
close to the centre that  
the electrons found  
on the outer orbits are  
so tightly held to the  
parent atom.

The electrons are  
not available on  
the metallic surface  
for the conduction of  
electric current.

To release any free electrons  
for conduction we may  
require too much energy.  
Then we may result in destroying  
the metallic structures.

In their Natural  
State these materials  
do no support the mass,  
hence do not allow  
electric current to flow  
through them.

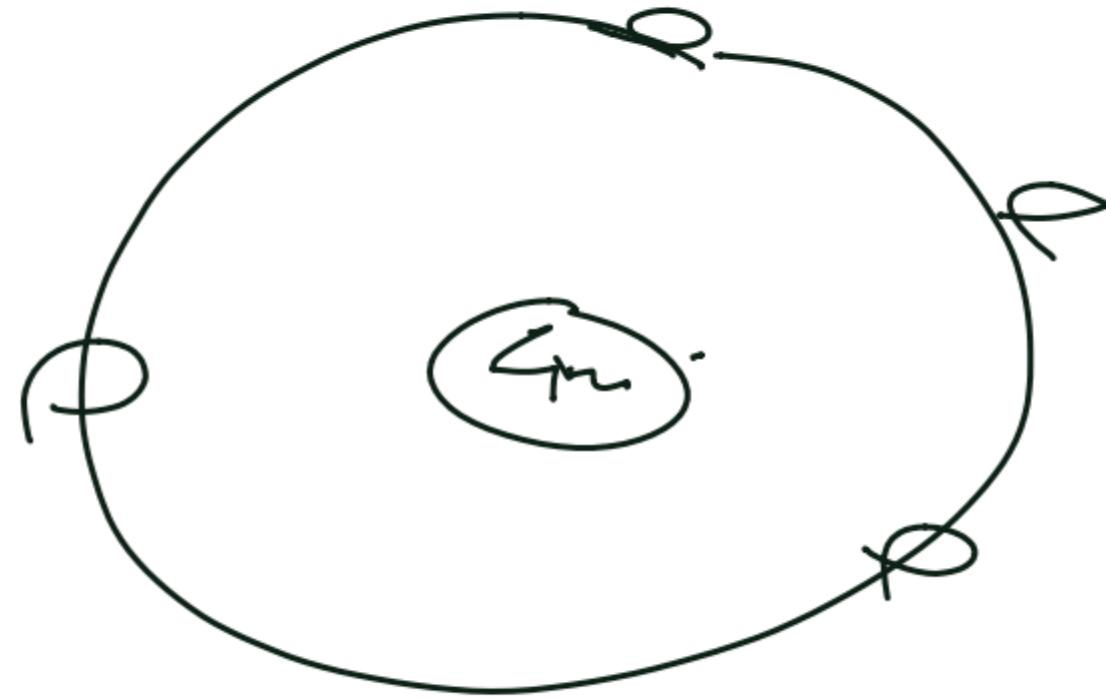
## Scandies

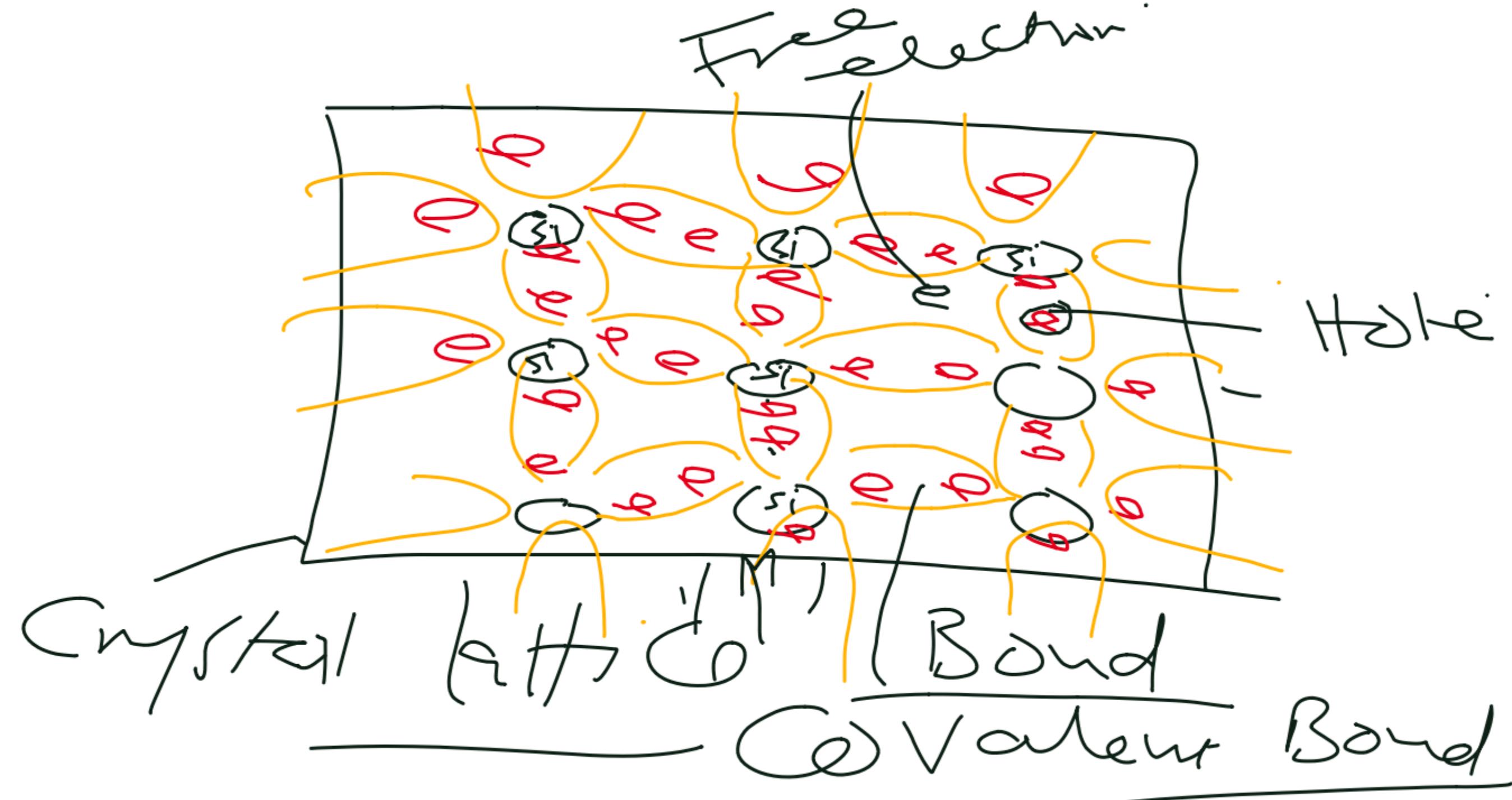
Rubber ,  
P.V.C .  
Plastic .  
~~Dry wood~~  
Paper  
Sand -

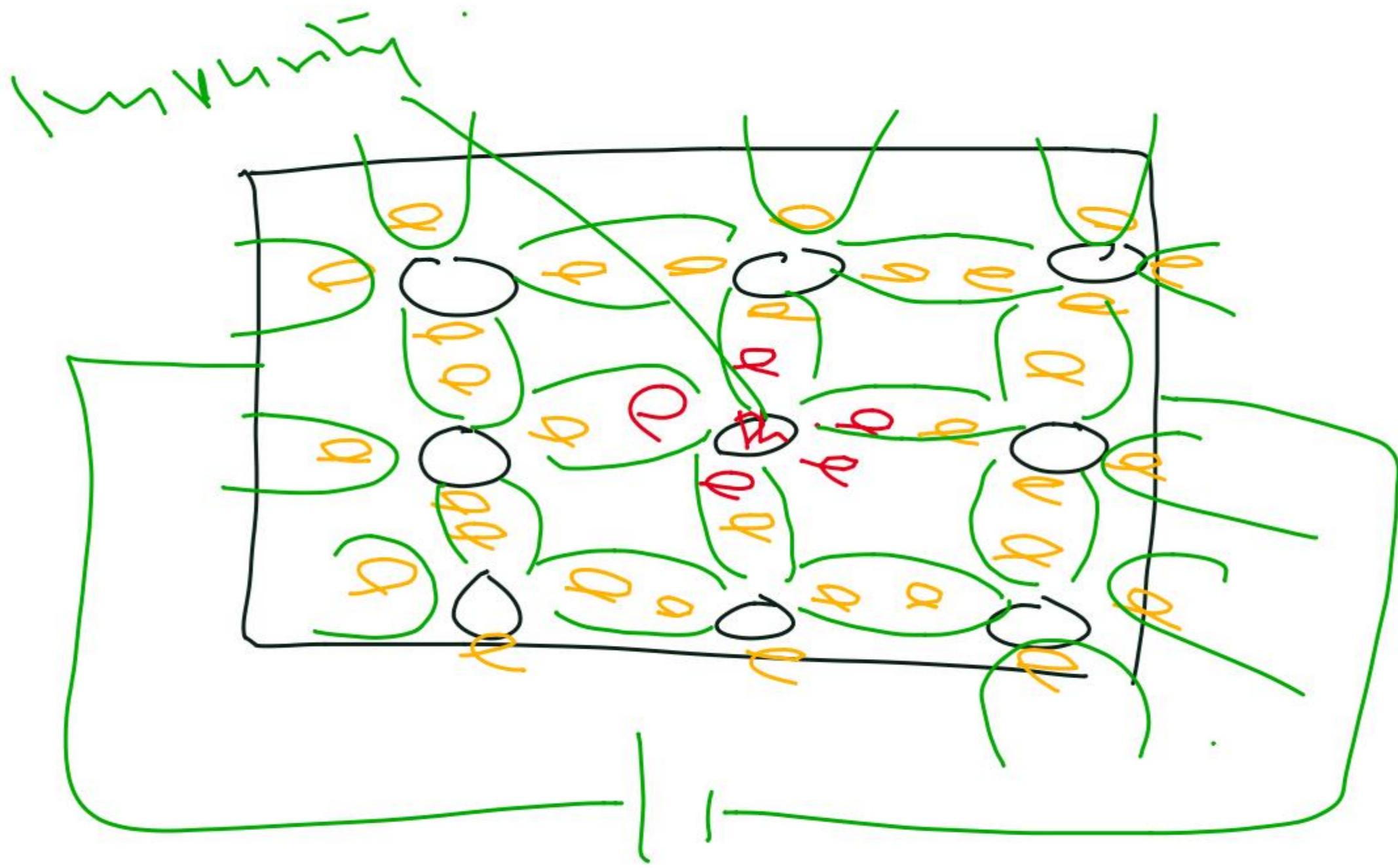
Teatle  
Impregnated  
~~Teatle~~  
- Impregnated Paper.

## Semi-conductors

These are Materials  
whose Atom's Structure  
and such their outer  
outer orbit have  
four Valence electrons.  
They fall under the Group 4  
Category in the Periodic







# Elementes

- 1) Silicium
- 2) Germanium.

# SEMI-CONDUCTION

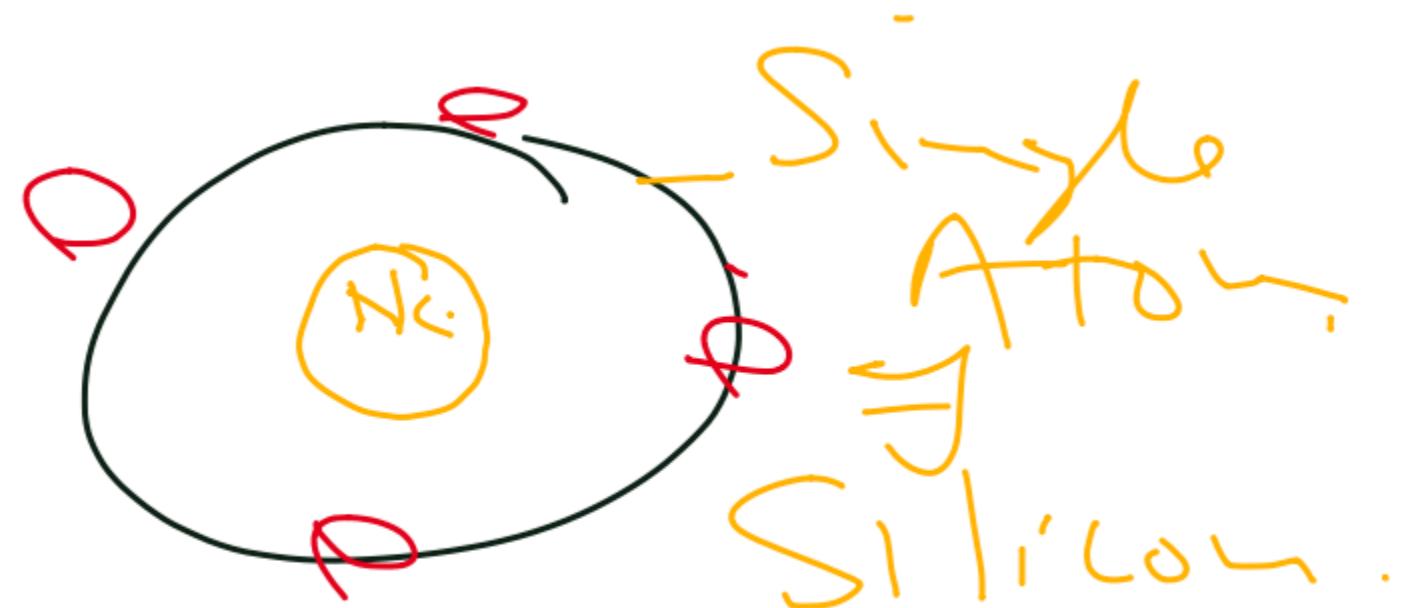
## Technology

In this category of materials we are going to discuss two types of the semi-conductor materials namely Silicon and Germanium. The study involves their structures and uses.

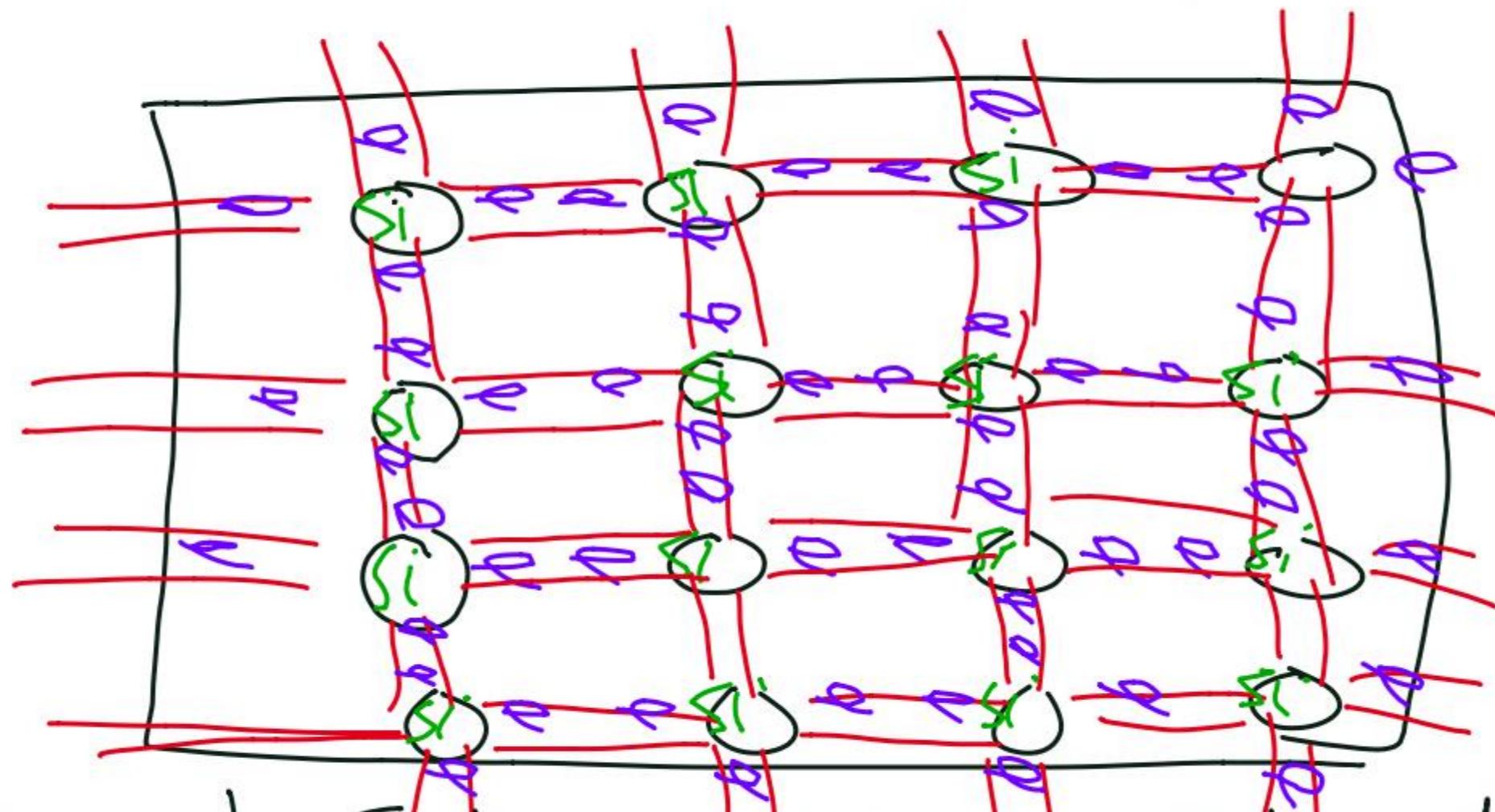
is this making of  
electrical and electronic  
devices.

## Silicon

This is a  
group four  
substance of  
the Periodic  
Table.

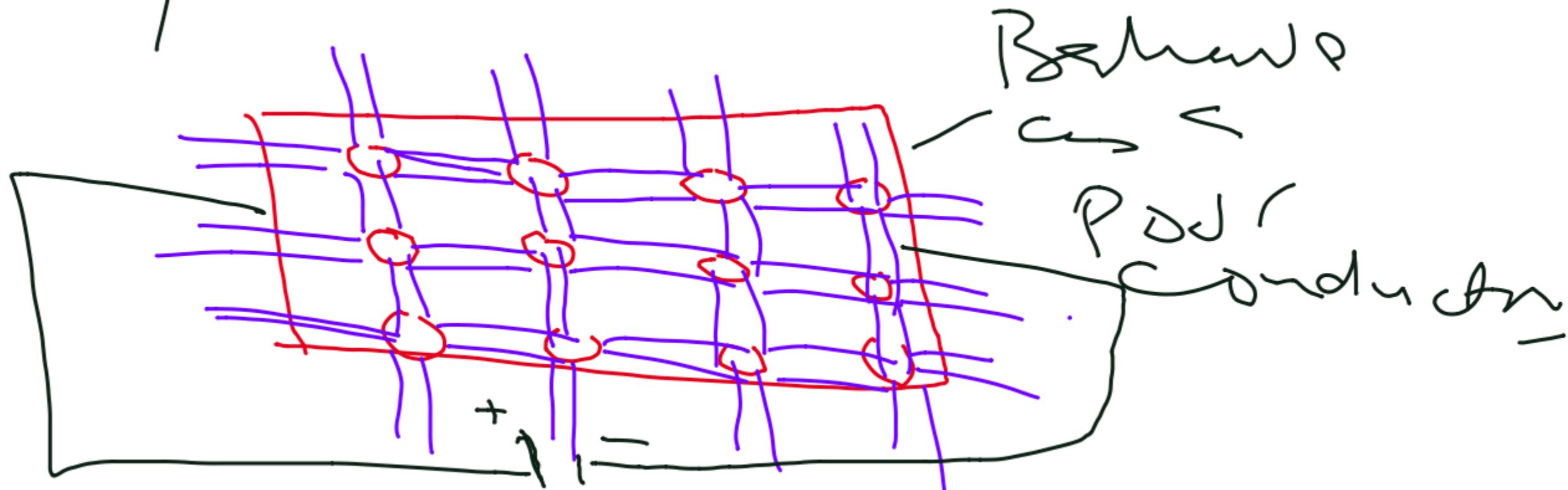


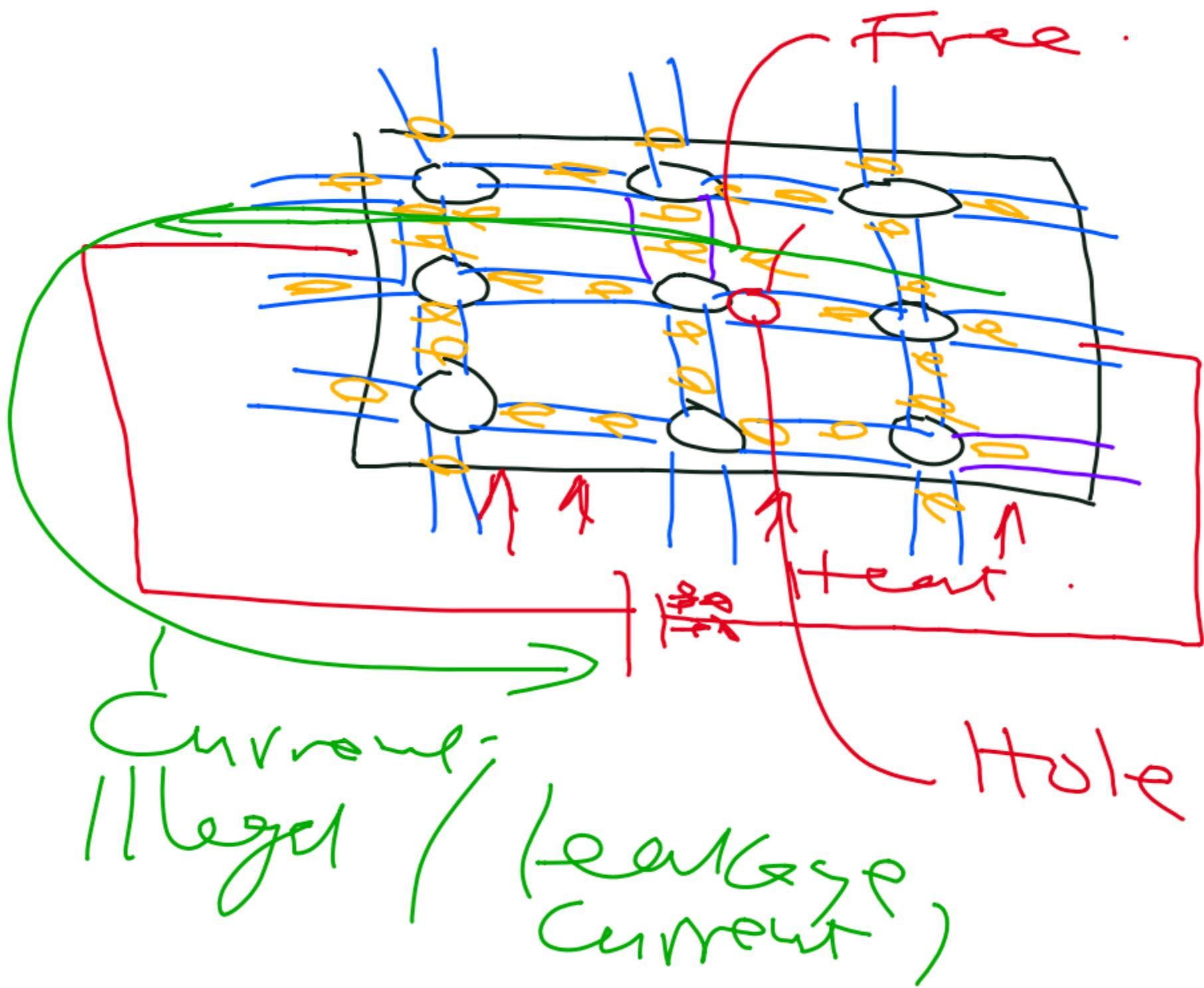
# Material Structure

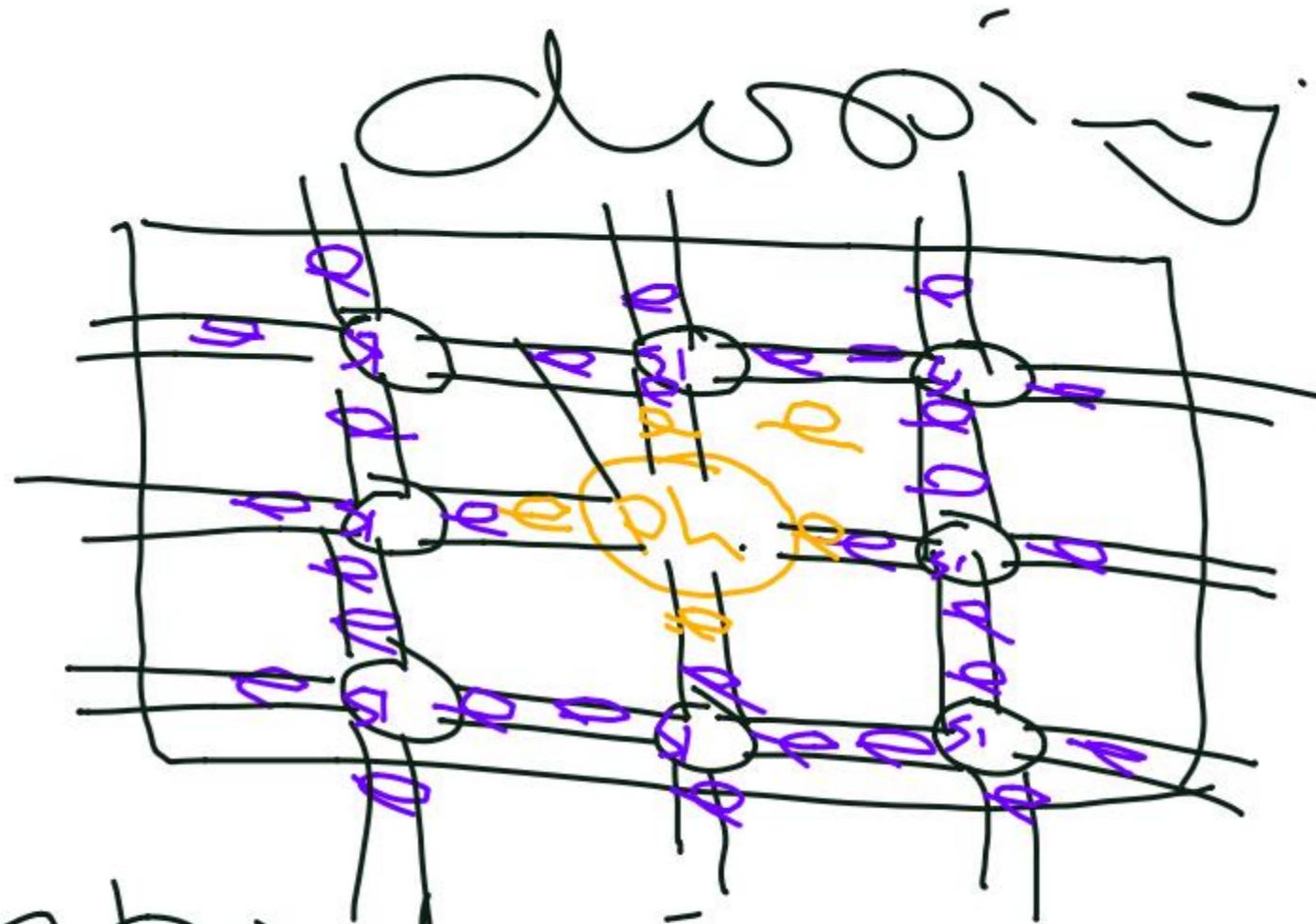


Several silicon atoms joined together to form a crystal lattice.

Through Covalent-Bonds hence it is  
Structurally  $\Sigma$  a  
Physical Silica.







By introducing  $\text{P}$  Plusphosphorus  
Atom into  $\text{Si}$  Structure in  
Silicon Crystal / lattice an  
extra free electron is generated

In the Structure of the

Semi-Conductor Material

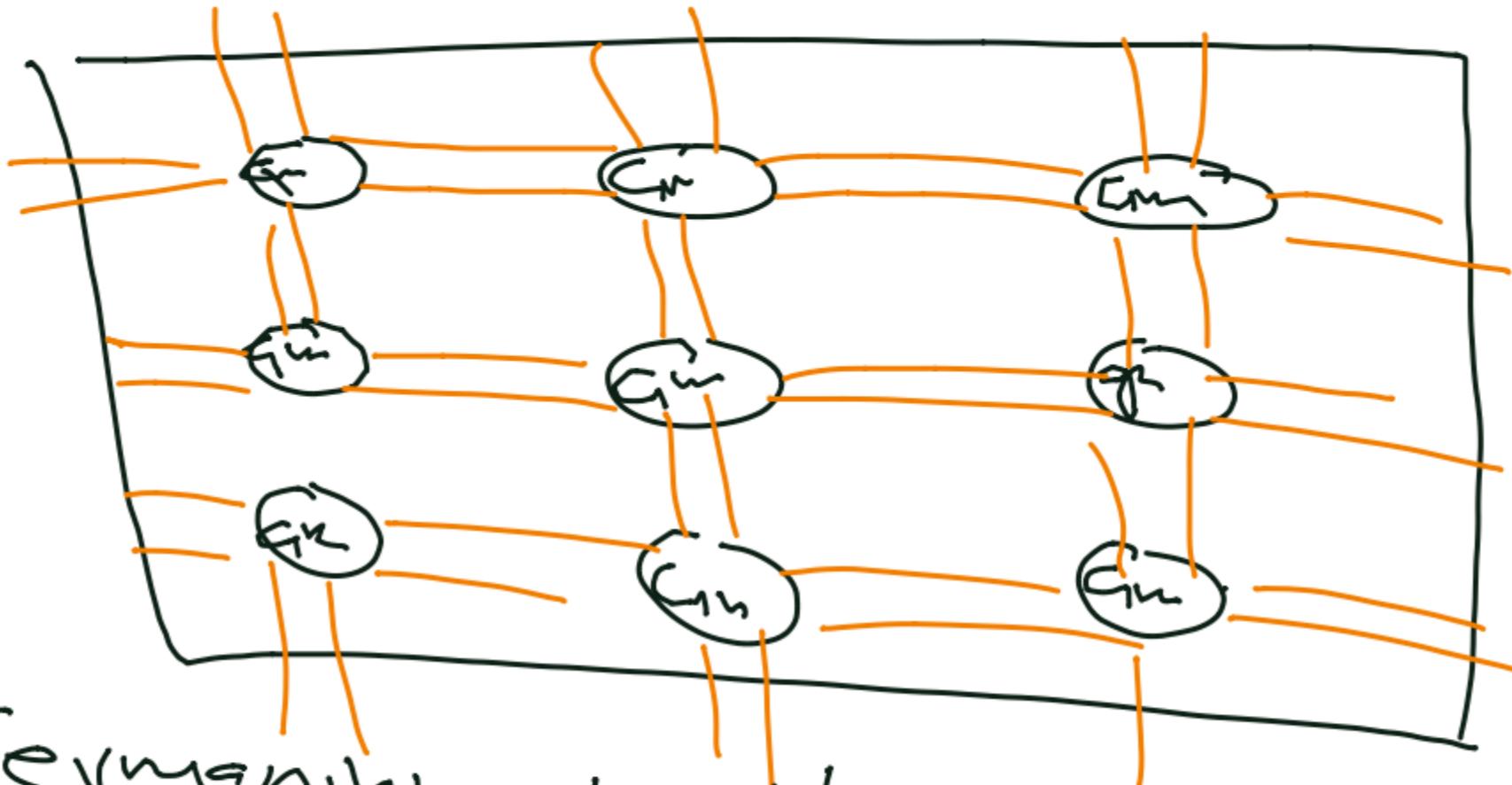
This Mainly makes Silicon Crystal Lattice Impure  
thus Making the Crystal Lattice  
become a Good Conductor  
of Electricity.

The Process of Introducing  
the Impurity Atom into  
Pure Silicon Structure is Known

The Impurity that we introduce to the Semiconductor to make it a good conductor is known as Dopant Impurity or a dopant Atom.

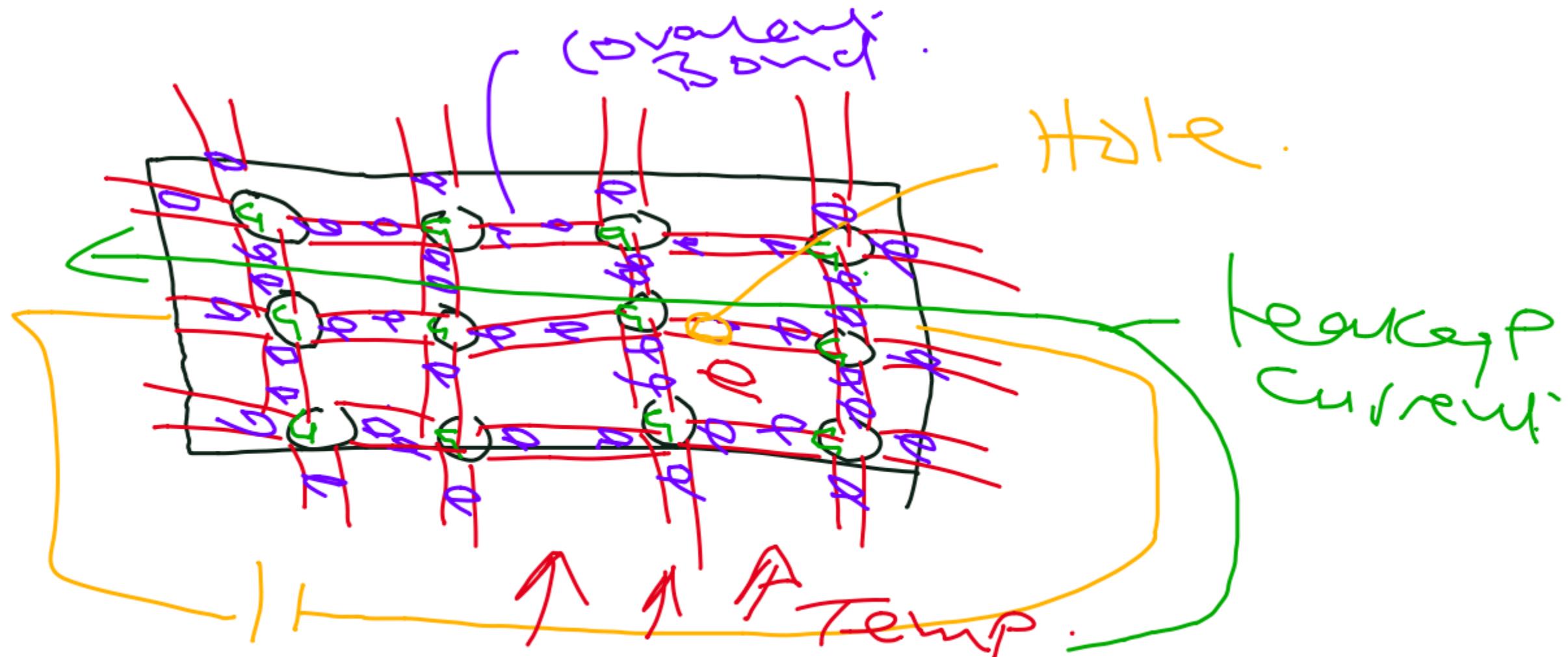
### Germanium

This is a group 4 element in the Periodic Table. It has four electrons on its outermost orbit:



Germanium in its Pure form is a poor conductor of electricity. It is a II type element. One Valency orbit + one bond = one shared (covalent) bond.

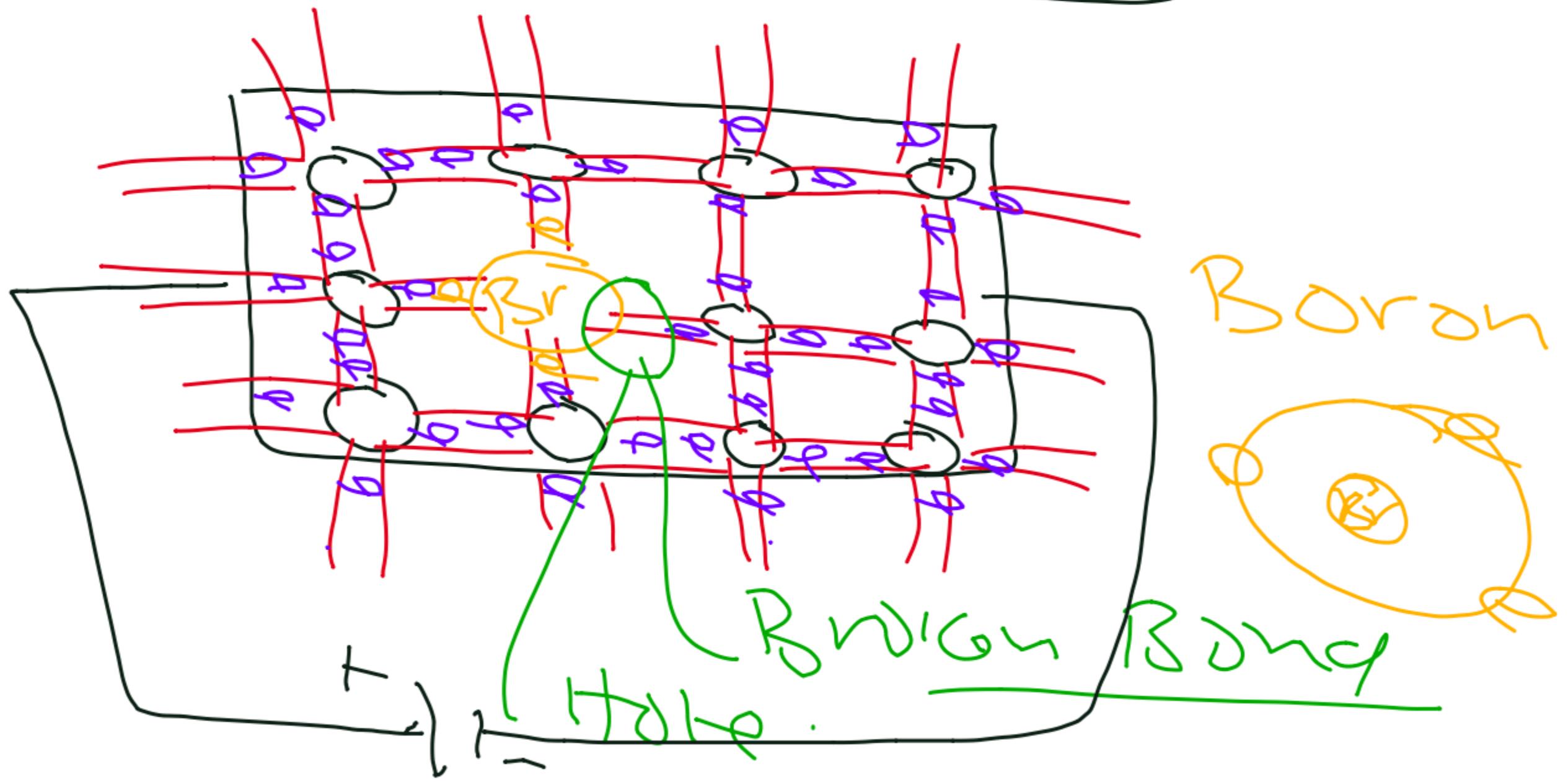
There are no free electrons to participate in the electric current -  
Gold丝.



The Pure Germanium  
will experience some  
broken Bonds due to  
increase in temperature.  
This will result in  
leakage current flowing  
through the material.

The electron in the weak  
bonds will be liberated and  
set-free from the bonds and  
thus be available for conduction.

# Germanium as a Conductor



## When the P-n-n

Germanium is doped using  
Boron Atoms in the  
Crytalline Grid becomes Germanium  
Good Conductor of Electricity  
This loss of result in the  
Boron Atoms creating two-deficiency  
of electrons in the covalent-  
Bonds i.e. creating holes.  
I.e. Creating holes.

## Types of Semiconductor Materials.

Two Semiconducting Materials  
are poor conductors.

For it to conduct - there is need  
for temperature of this material  
being raised to break some of  
the bonds. The electrons and  
holes that enable the conduction  
in the material are internally  
generated.

Therefore this type  
of Conduction is  
Known as Intrinsic

Semi-conducting Material if it is  
Pure form may be referred  
to as Intrinsic Conductor.

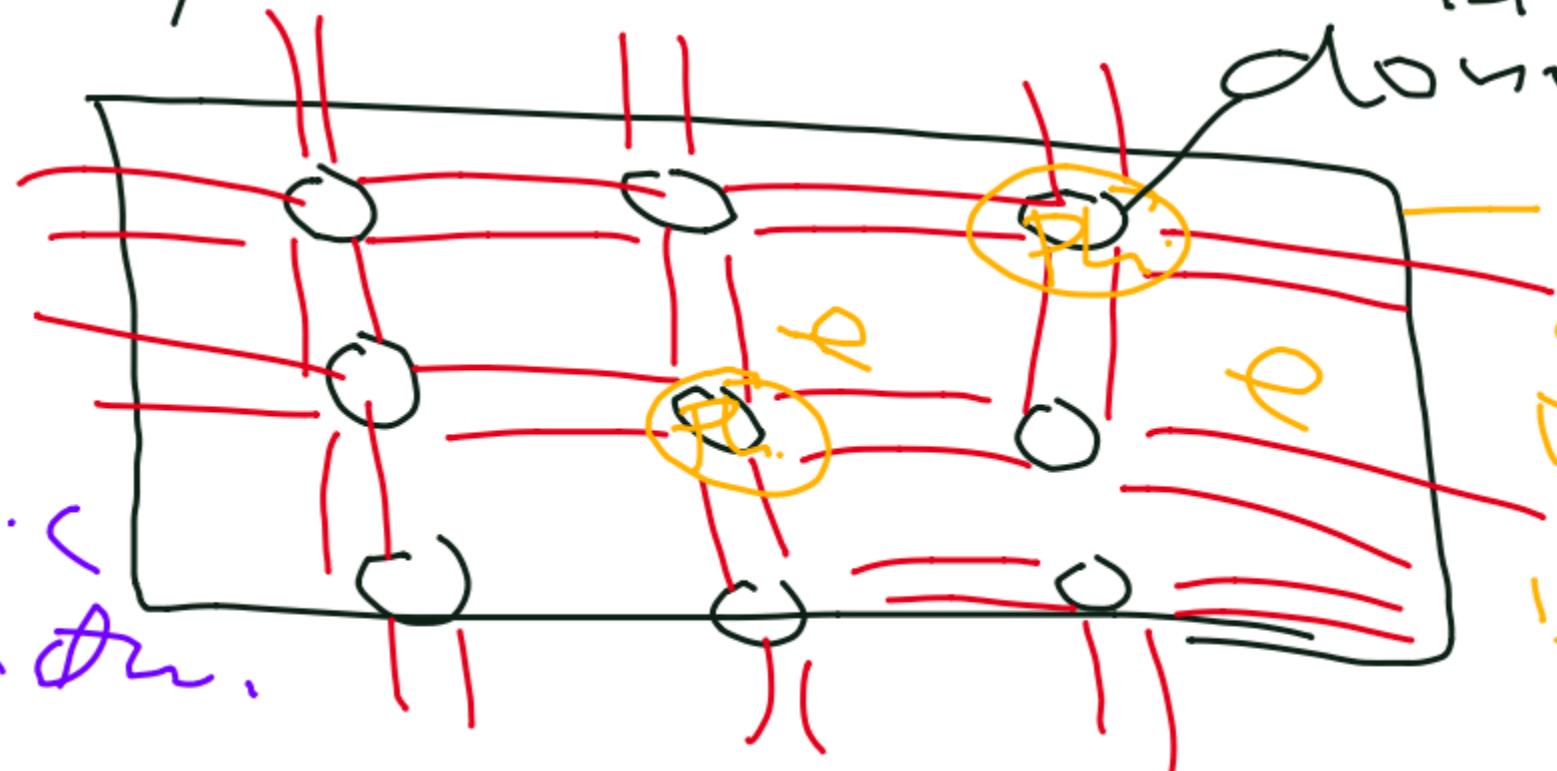
## N-type

When a pure Semiconductor material is doped with a Group Five element from the periodic table e.g. Phosphorus is the electrons are created in the structure. Since the electrons are negatively charged, the semiconductor

becomes predominantly  
negative Polarity  
therefore the name  
N-type



Extrinsic  
conductor.

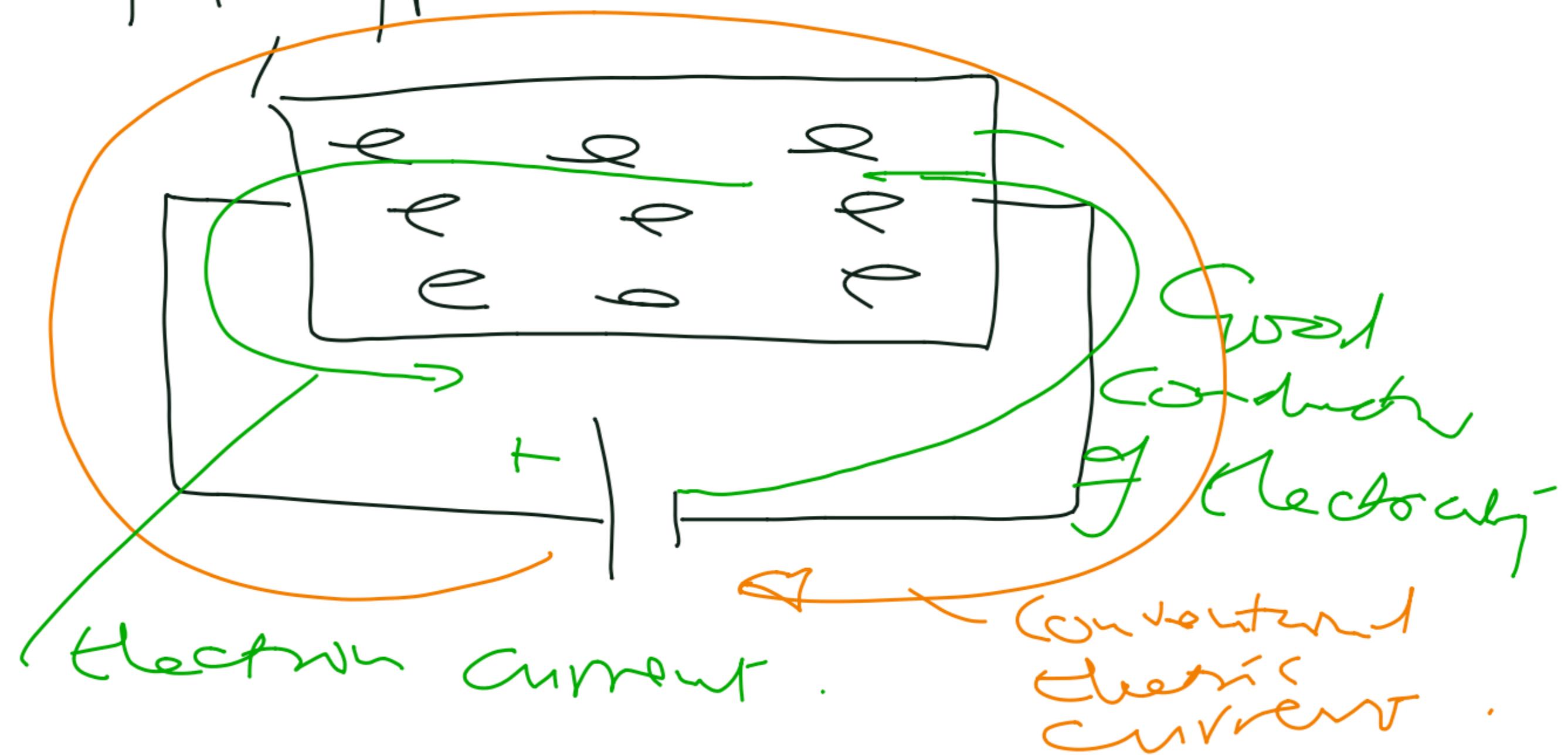


Semi-conductor option.

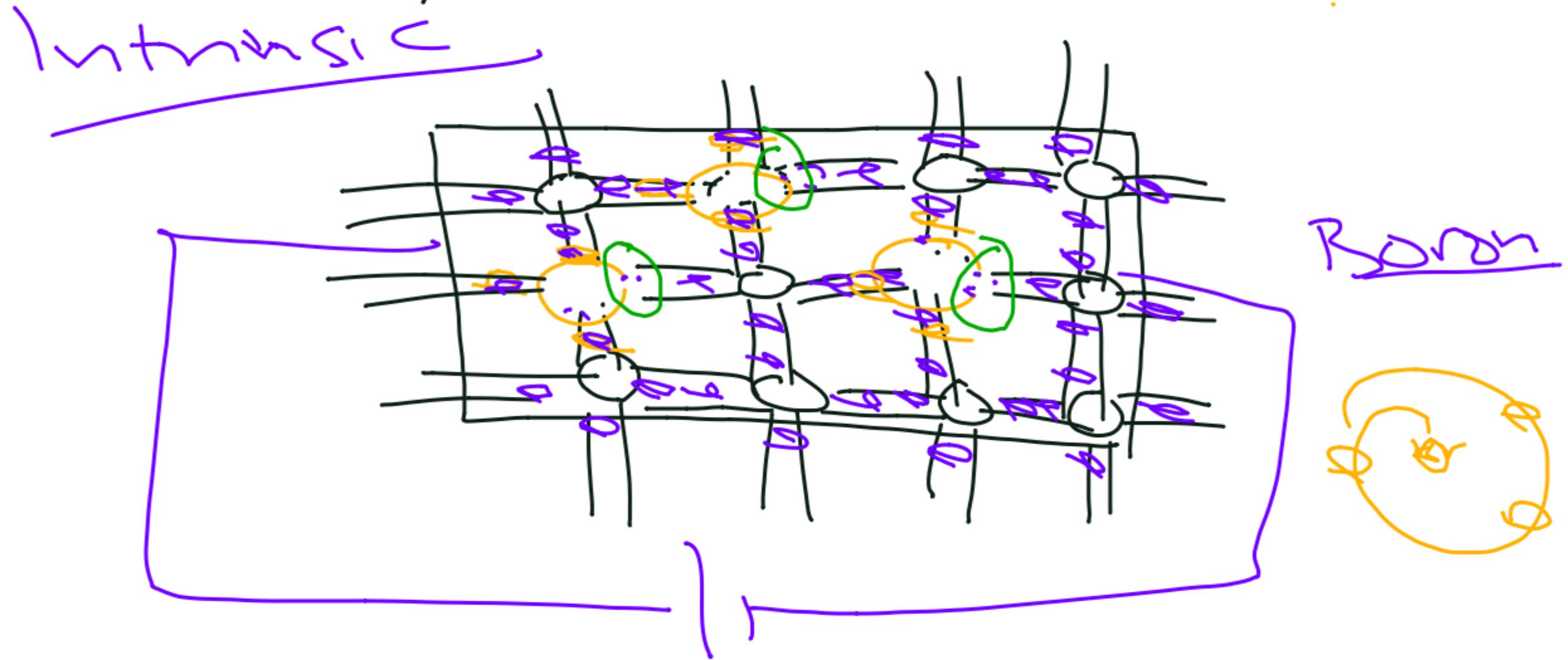
Negatively  
charged  
Material.  
N-type.

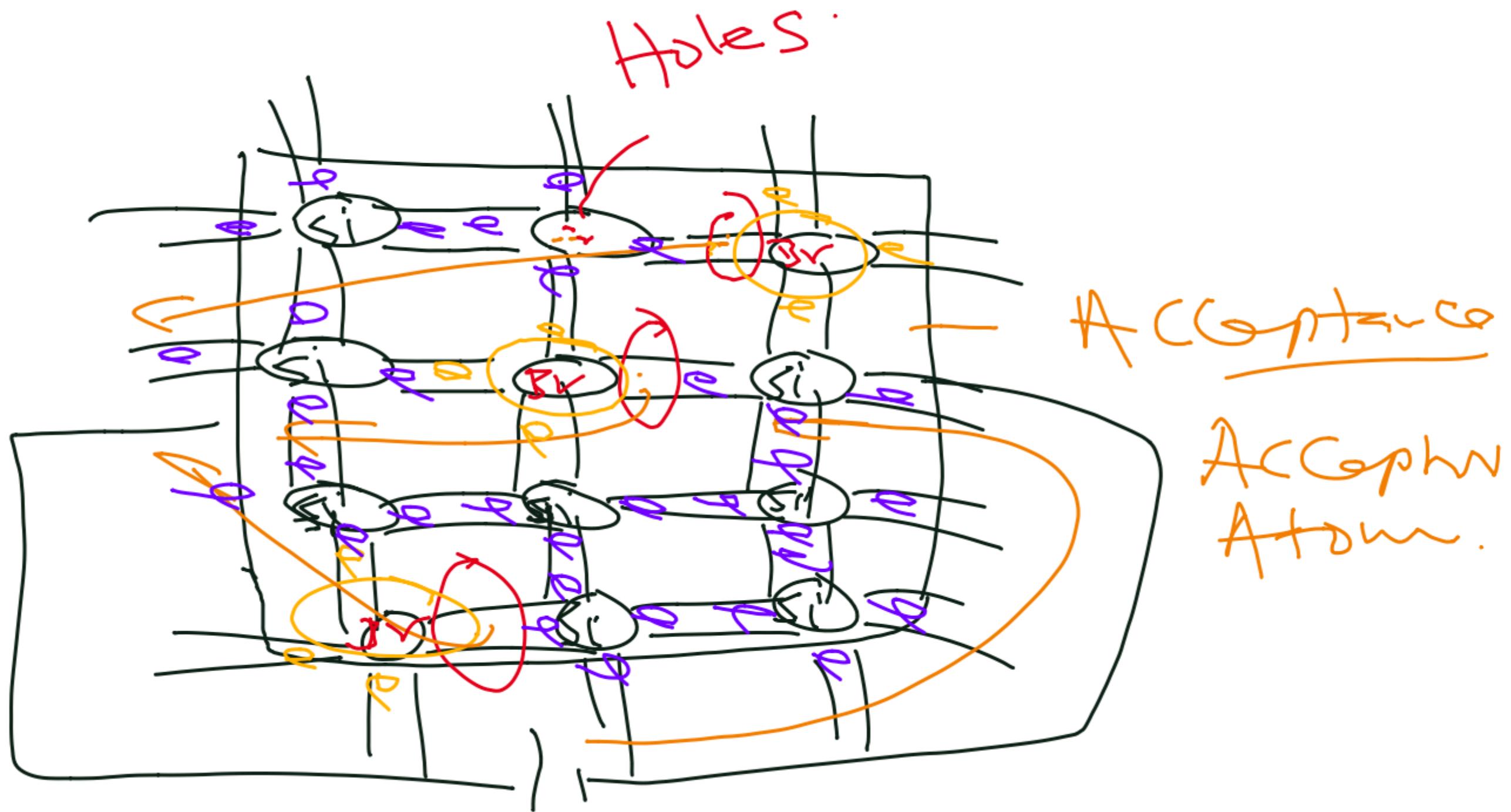
- Donor Atom.
  - Doping.
  - Donor Dopant
-

# N-type Semiconductor



# P-type Conduction



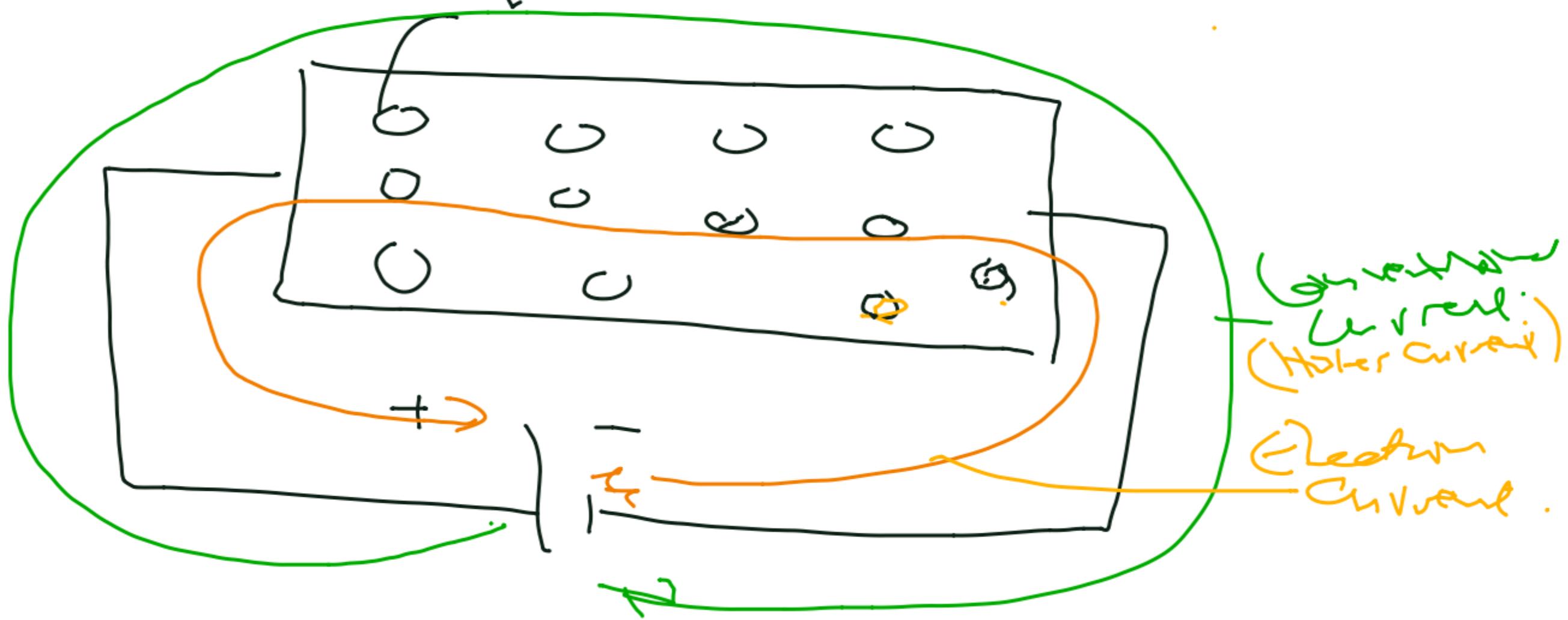


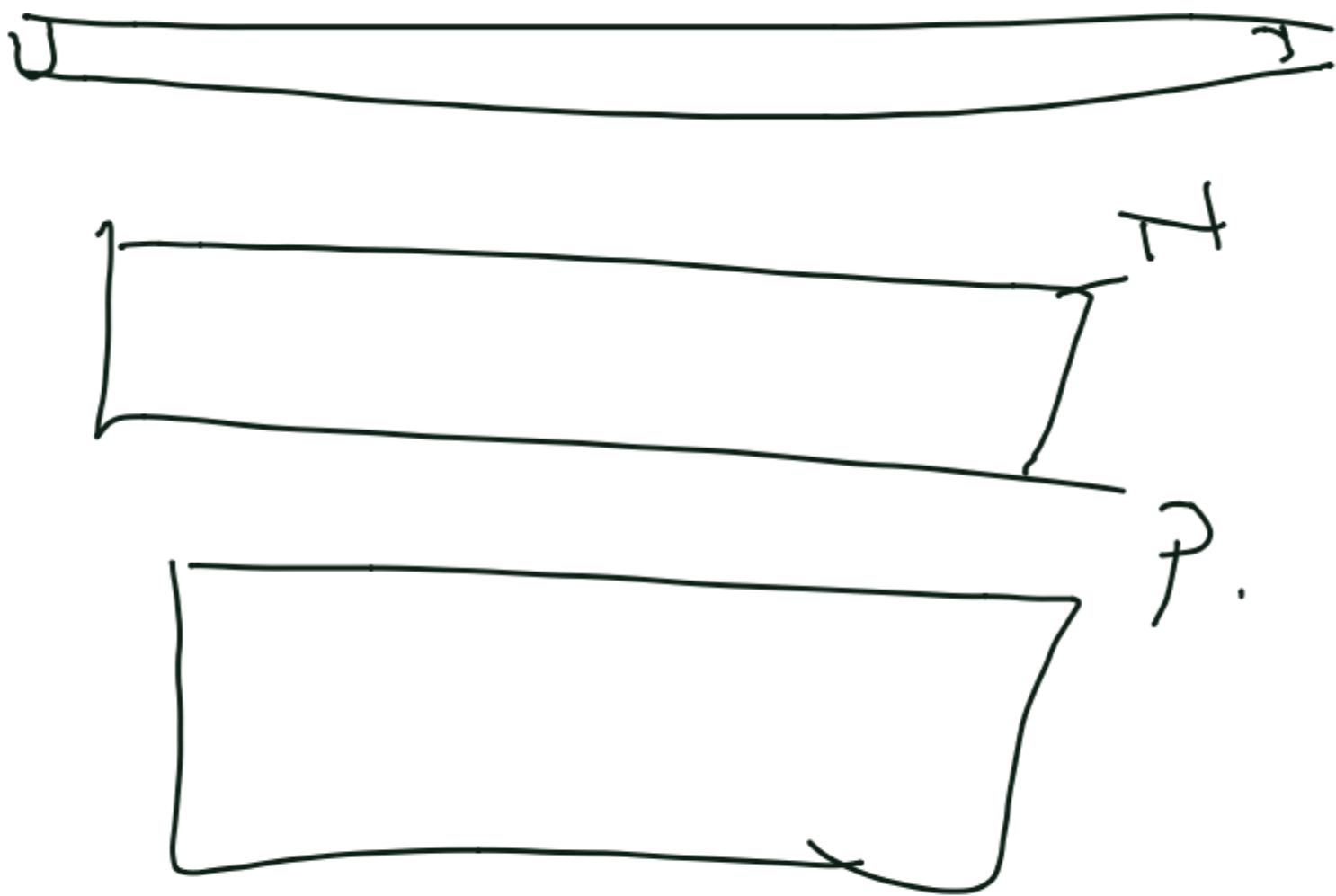
When  $\leftarrow$  Pure Silicon or  
Germanium Crystalline  
is doped with a Group  
THREE element, the Material  
becomes Negative of Electron  
I.e. Some of the Covalent Bonds  
give incomplete since there will  
be only one electron in the  
Union. This gives a result of  
a Broken Bond that will be  
Accepted an electron available.

The Atom used to  
dope the crystal lattice  
is known as Acceptor  
Atom.

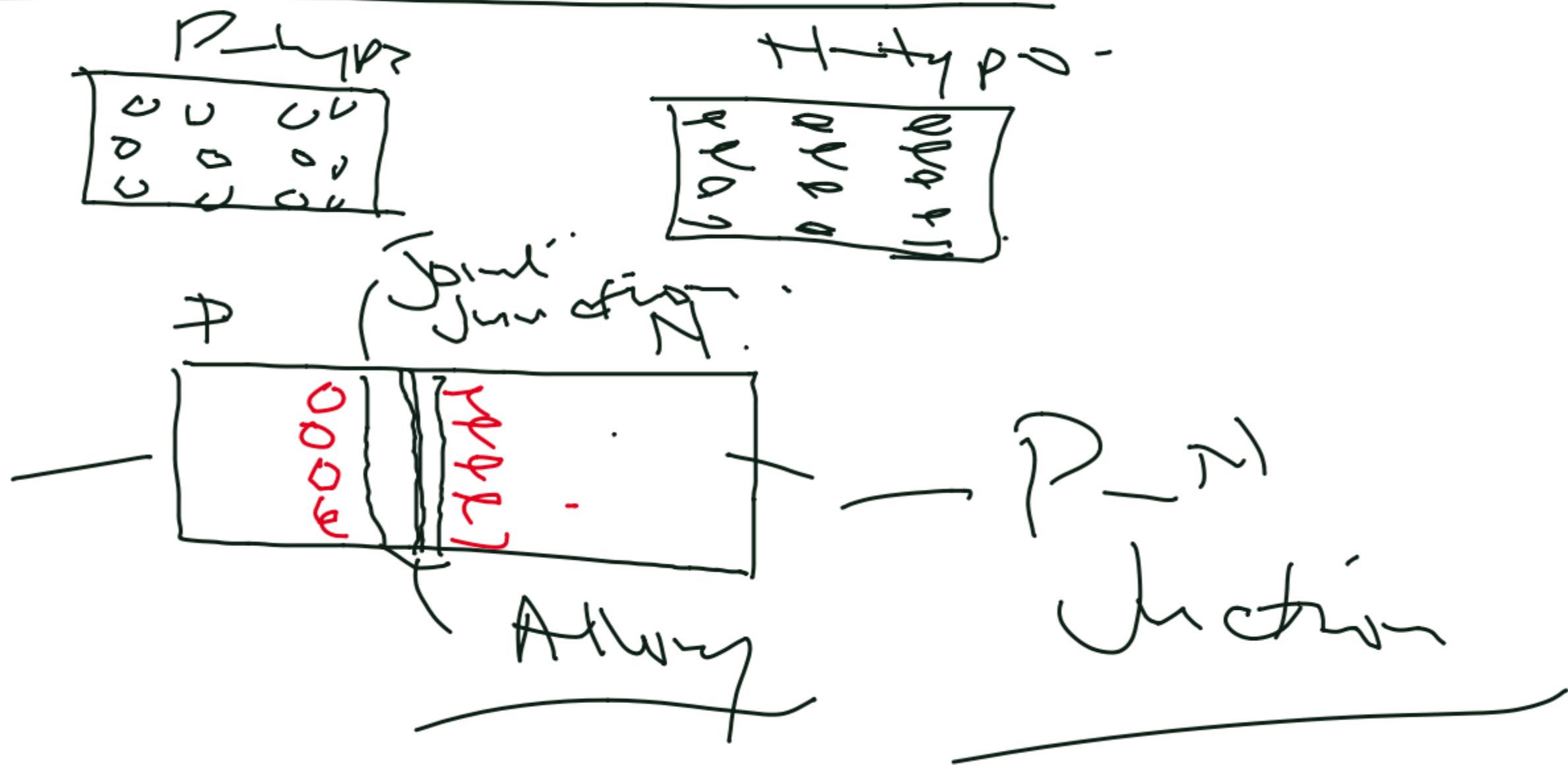
Since the charge is negative  
absence of electrons  
would mean a positive charge.  
The result of this doping is  
Positively Charged Material  
I.P - P-type.

~~P-type~~ - Extrinsic conduction  
Holes (free)





# Semi Conductor Devices



## P-N Junction

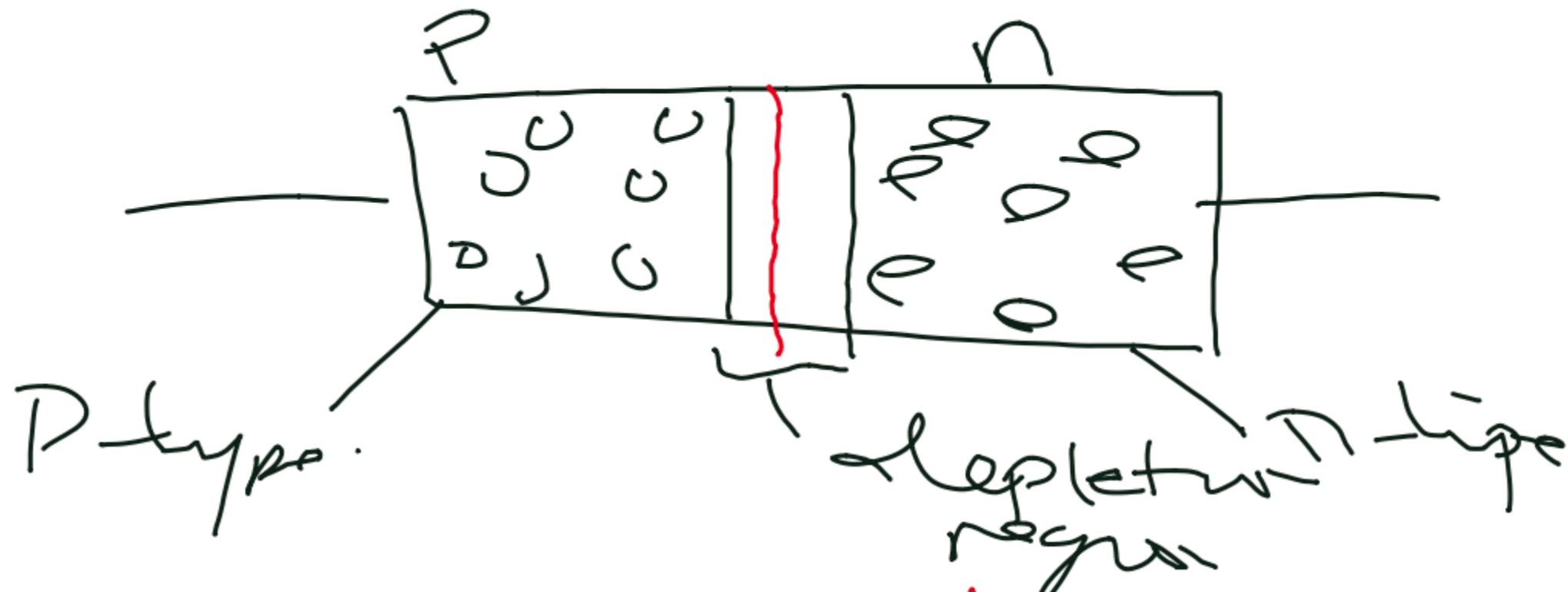


The joining of (Neutral  
the two pieces begin  $e$ )  
of material)  
thus N and Bande Gap  
P gives a P-N Junction.

At the Point-Junction-

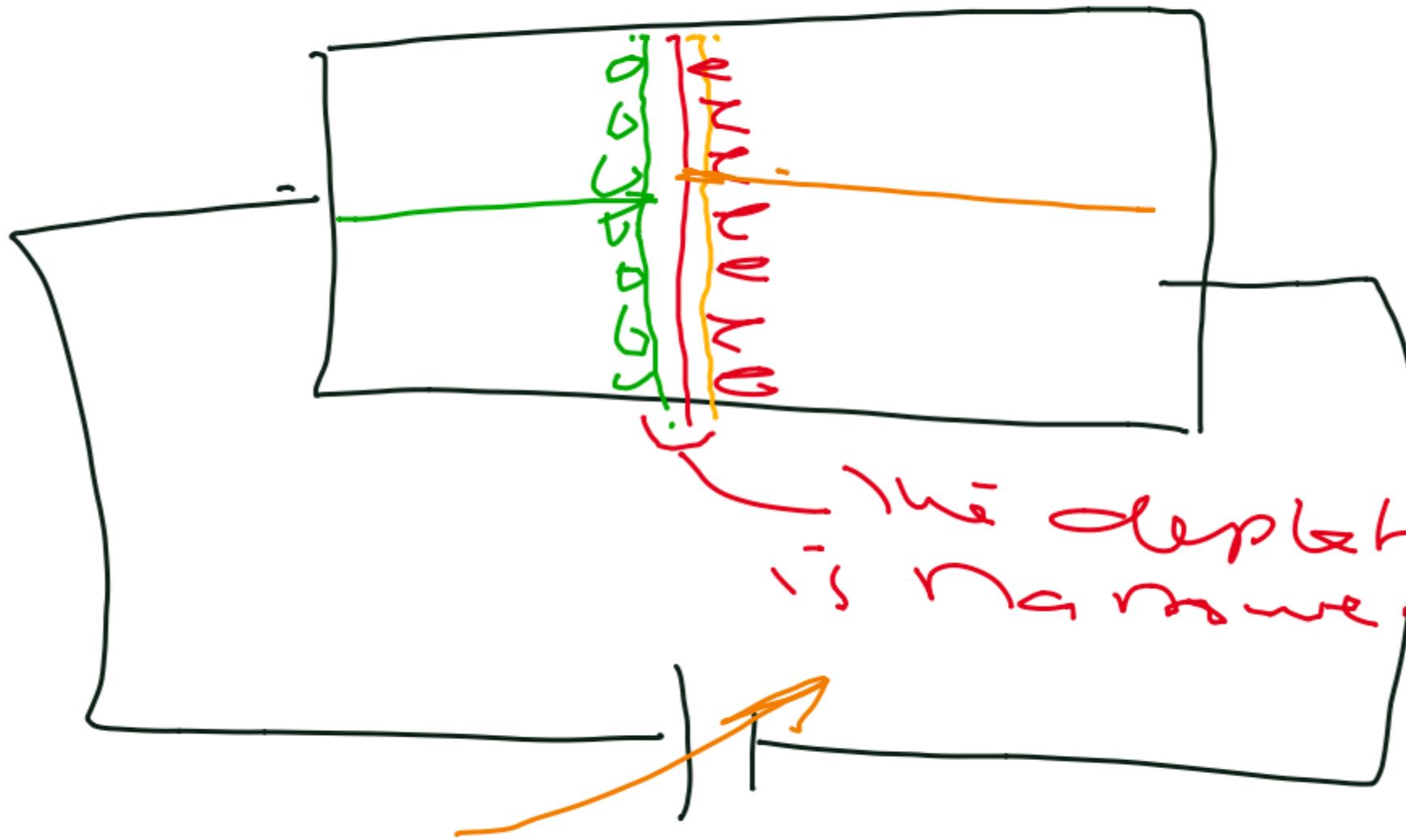
Buried Gap is created  
to block the movement  
of holes and electrons.

The Buried gap is depleted  
of the charge carriers leaving  
it in Neutral Polarity.

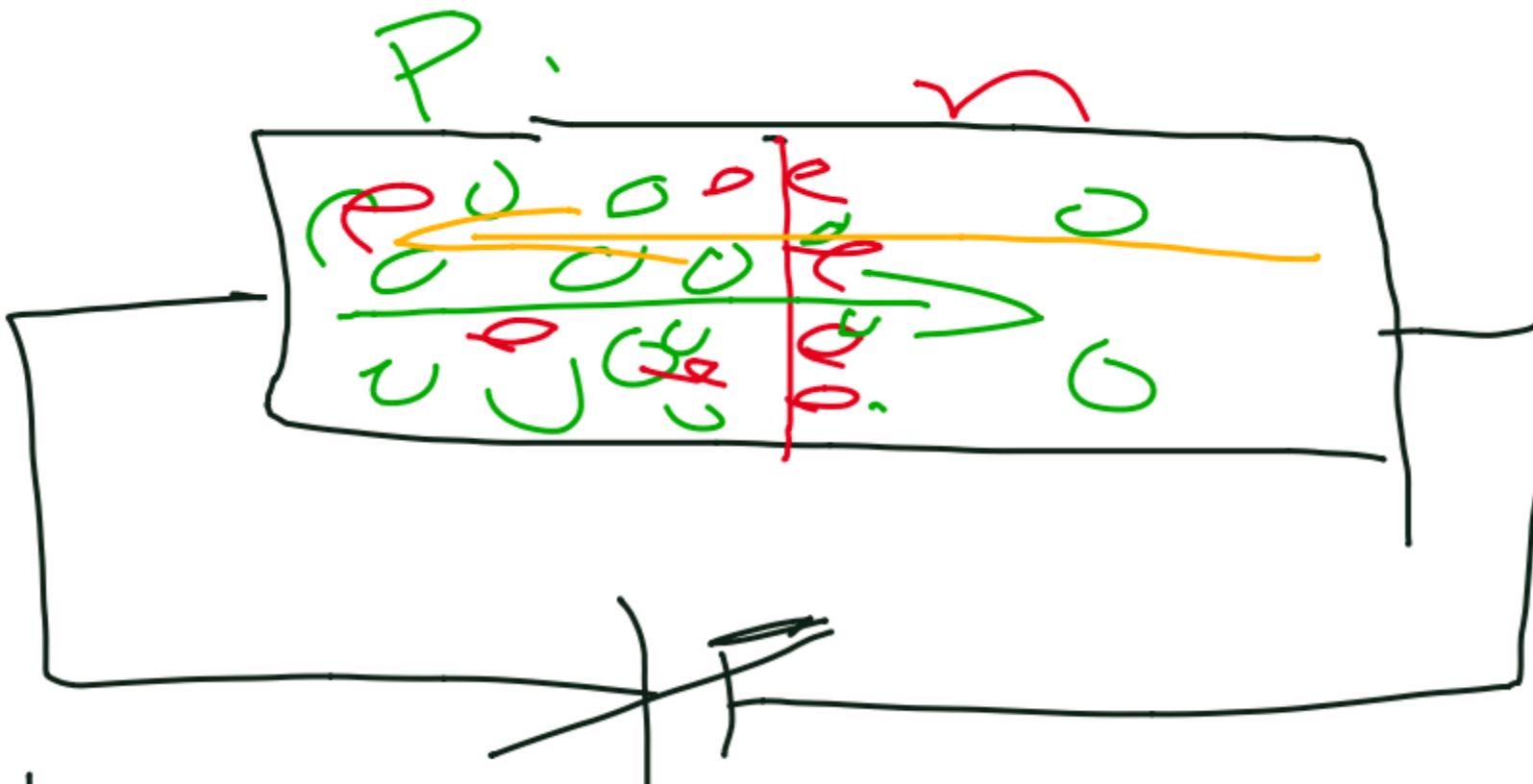


depleted  
The Charge  
Carries -





The deepest River  
is narrower.



Holes will be attracted to the negative terminal  $\Rightarrow$  low energy source  
Whereas the electrons will be attracted to the positive terminal

The Charge Carriers  
are said to be moving  
in the forward direction.  
The Junction is therefore  
considered to be

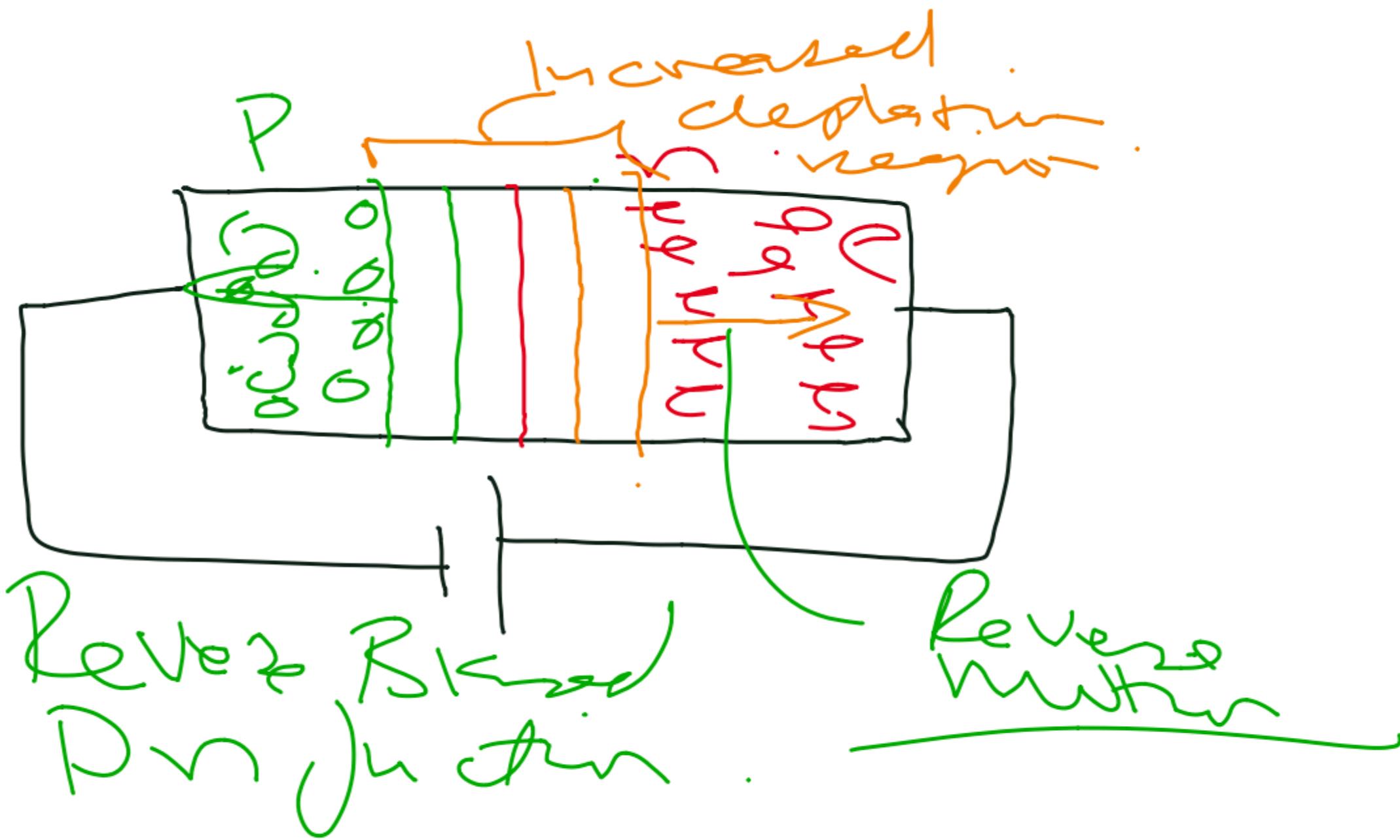
Forward Biased.

P-N Junction is forward biased when  
P-Material is connected to Positive.  
N-Material is connected to Negative.

The Forward Current  
Machine will flow in  
the Circuit.

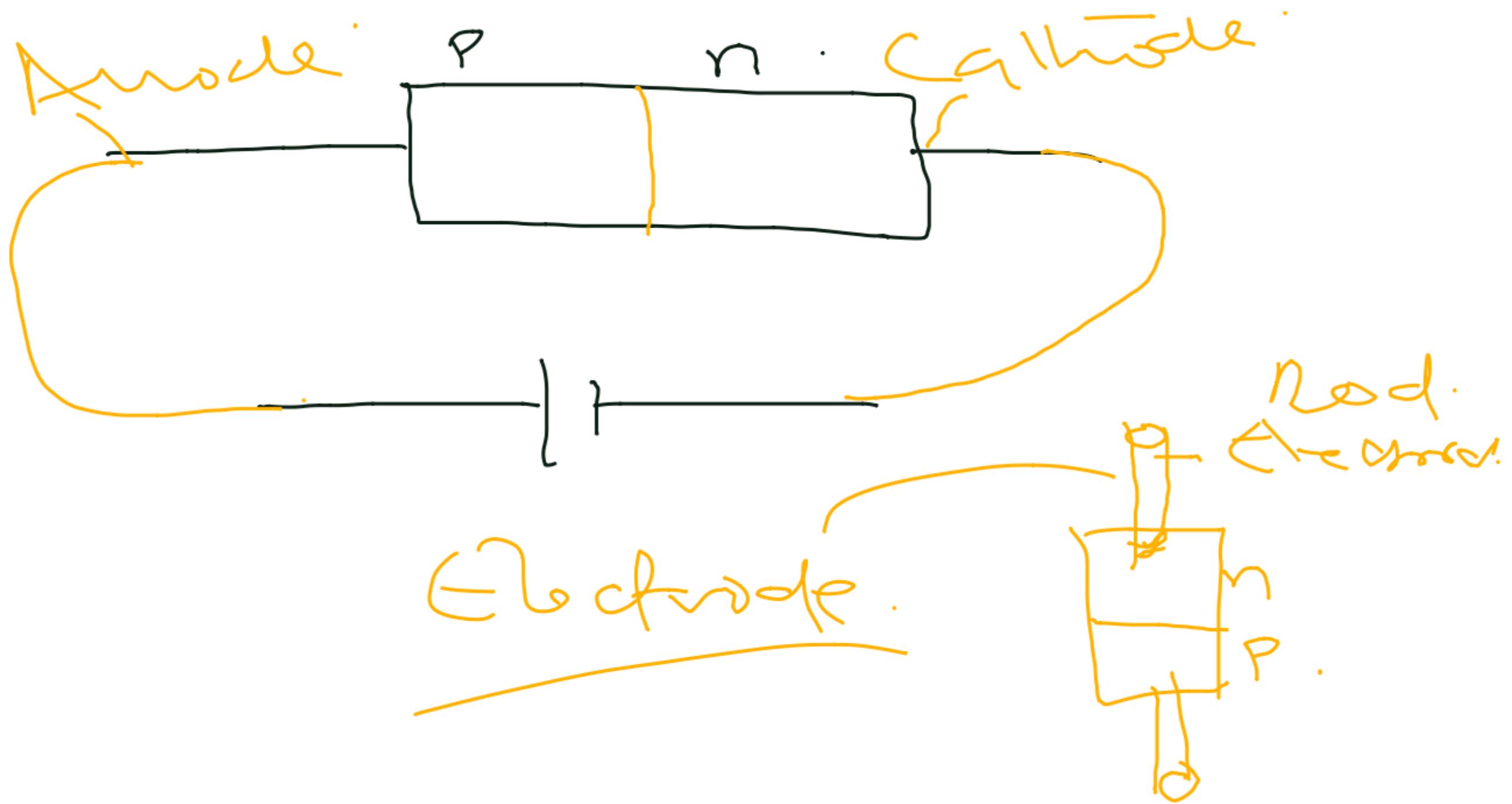
CASE 2





When the P side  
of the P-n Junction is  
connected to the negative  
terminal of the energy source  
and the N-side to the positive  
terminal the charges  
comes will be attracted  
such as to give a way from  
the P side of Junction.  
The charge comes are moving  
back into the P-type material.

No Charge Current and  
Variable AC-Line  
Inertia to Facilitate  
The Electric Current-  
Flow. The Device is  
Said to block the Circuit-  
Flow. The Charge Cam is  
One in Reverse Motwt when  
the device is in Reverse Biased  
Mode of Operation.

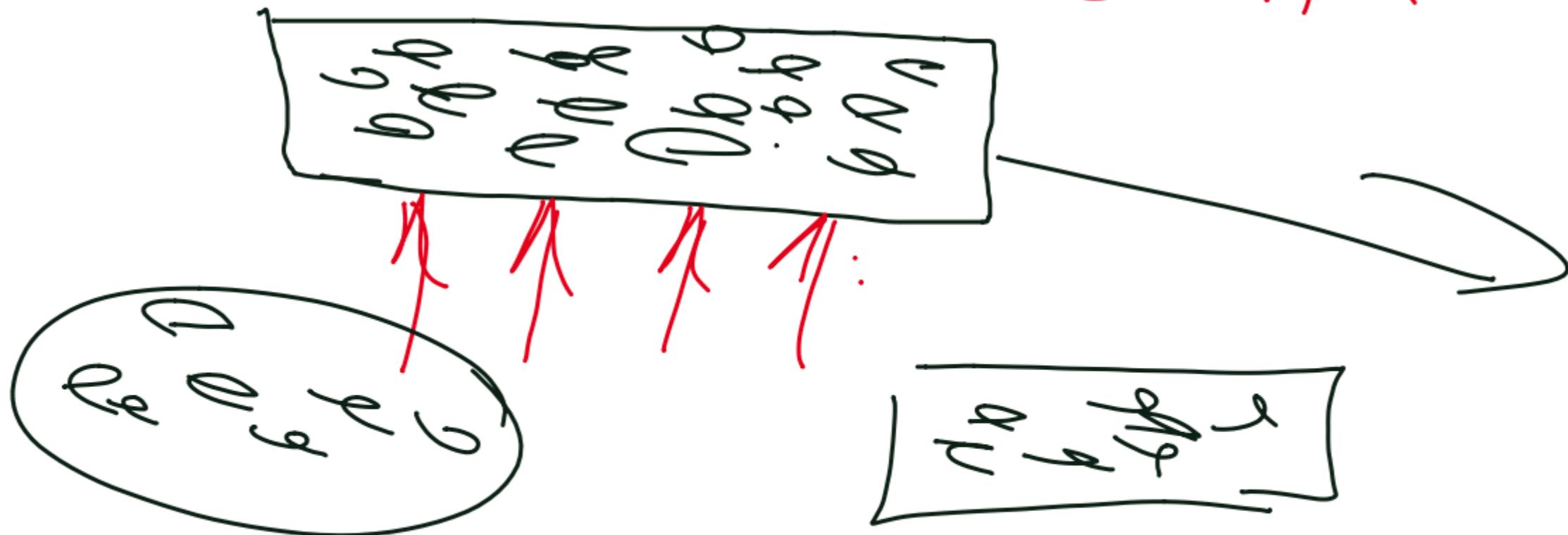


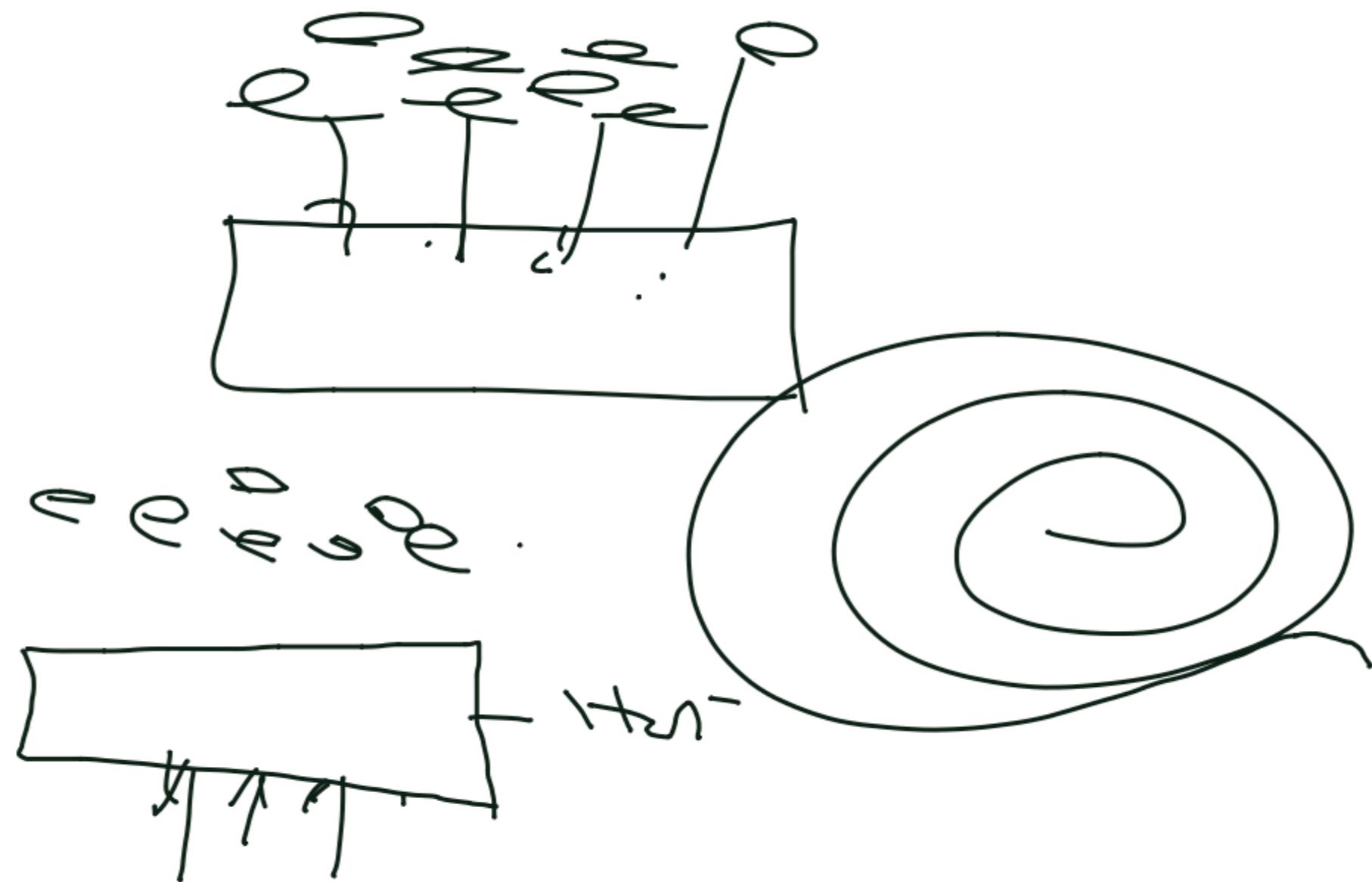
The Two Electrodes  
Are Formed as  
Follows:

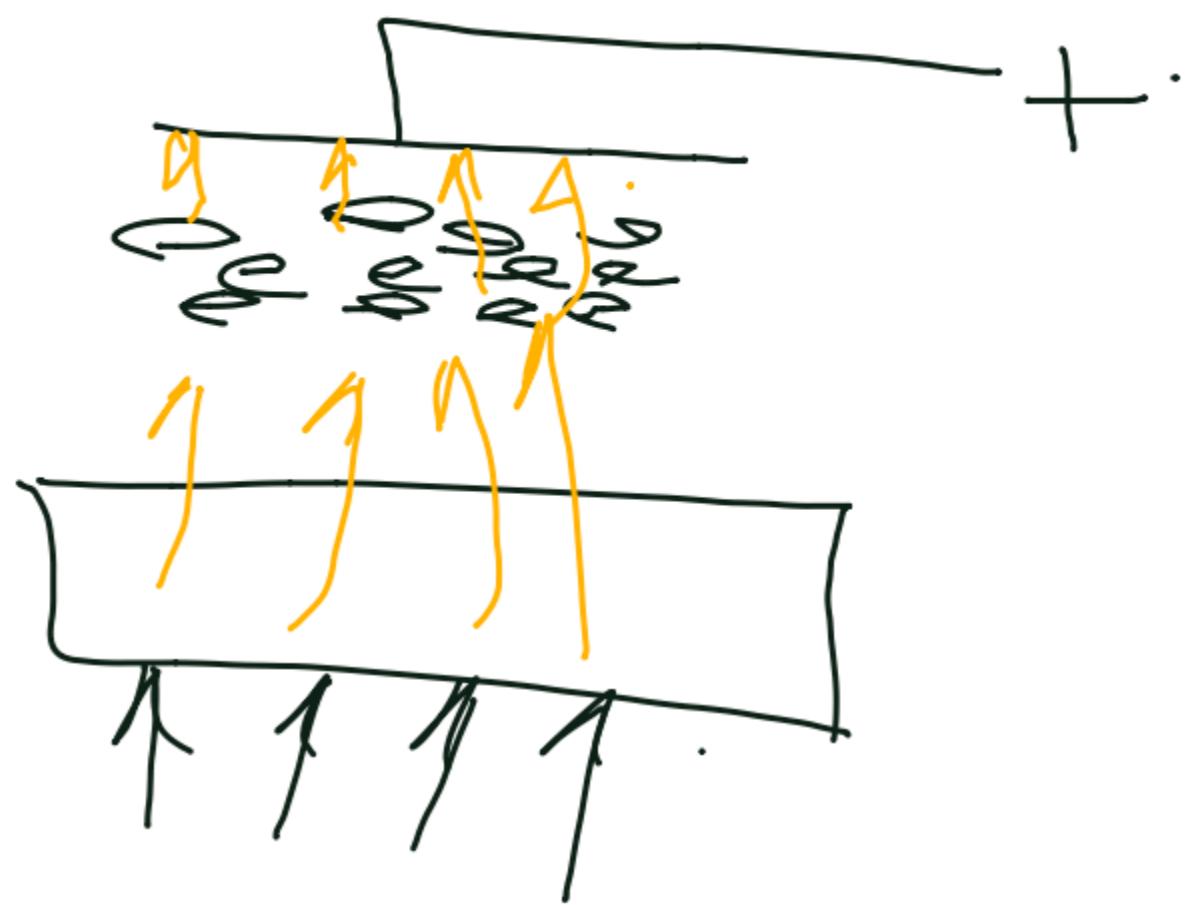
The one Connected to the  
P-type Material is Anode.  
The one to the N-type material  
is known as Cathode.

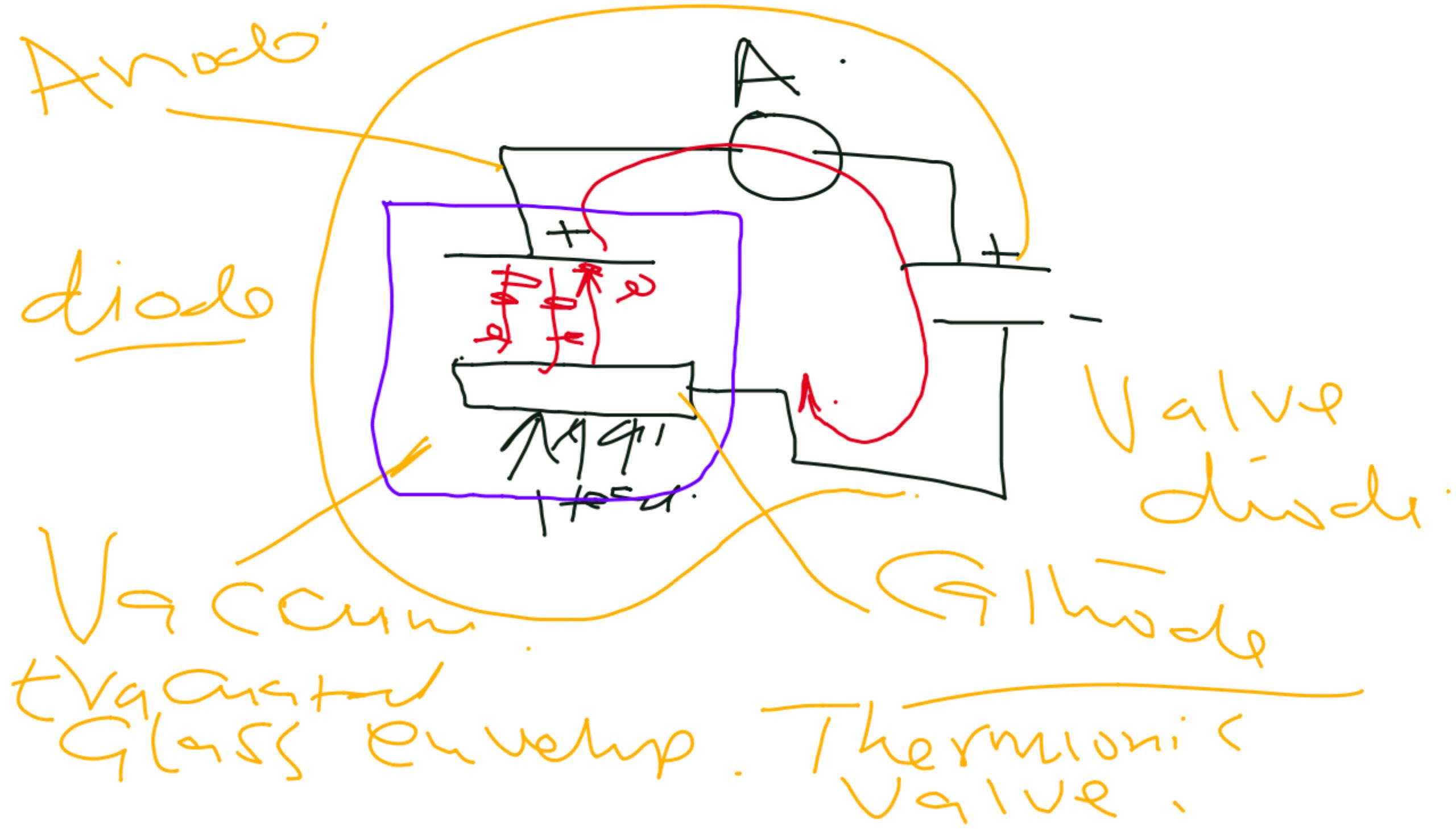
# Hot Metal.

Gibbs free energy closed  
Negatively Charged.









When the Anode  
Plate is made Positive  
With respect to the  
Cathode gives the  $\rightarrow$  choice  
Plate is made negative  
With respect to the Anode  
The dye is said to be  
Forward Biased if it will  
allow current to flow through  
the vacuum.

Anode

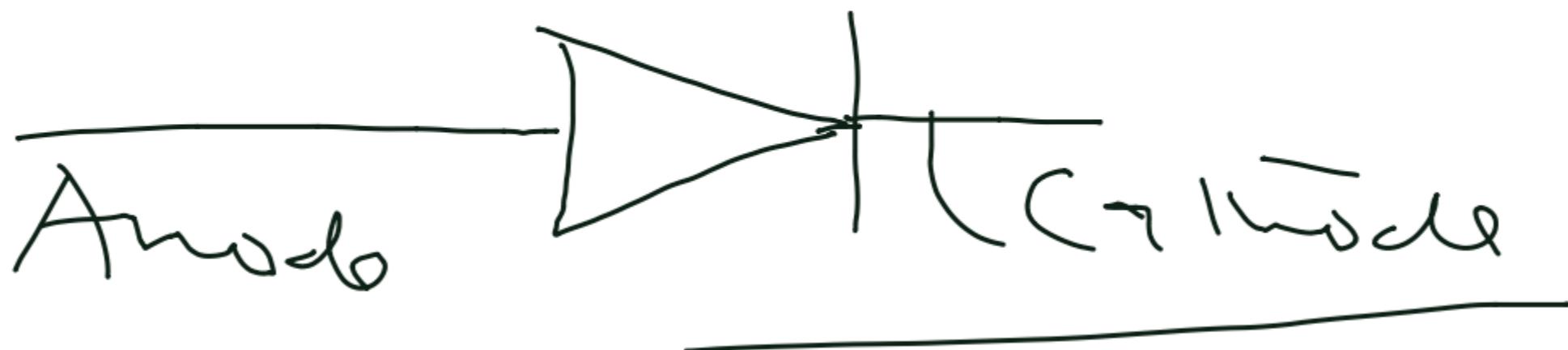
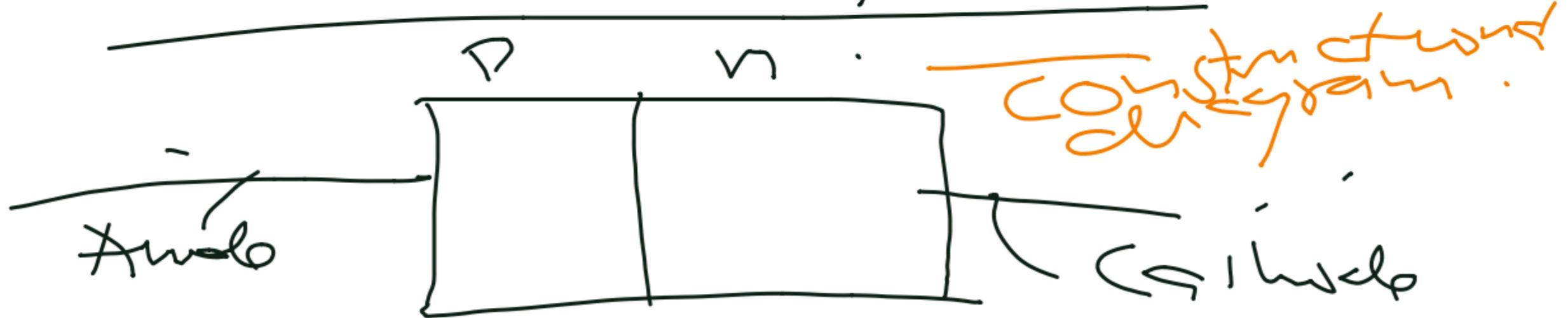


G / hode

When the G / hode - Plate is  
Made Positive will response to the  
Muscle and the Anode  
Plate made Negative will response to

When the Anode  
is Connected to the  
Negative terminal of the  
Energy source and the  
Gloss to the Positive  
the Device is said to  
be Reverse Biased and  
No Current is experienced  
over the Circuit.

# Electronic Circuit Symbols



# APPLICATION ADDRESS

For P-N Junction  
Diode

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- 1) Power Rectification.
- 2) Signal Detection.
- 3) Signal Clamping.
- 4) Signal Clamping.
- 5) Modulation.
- 6) Display Units (LCDs)
- etc.

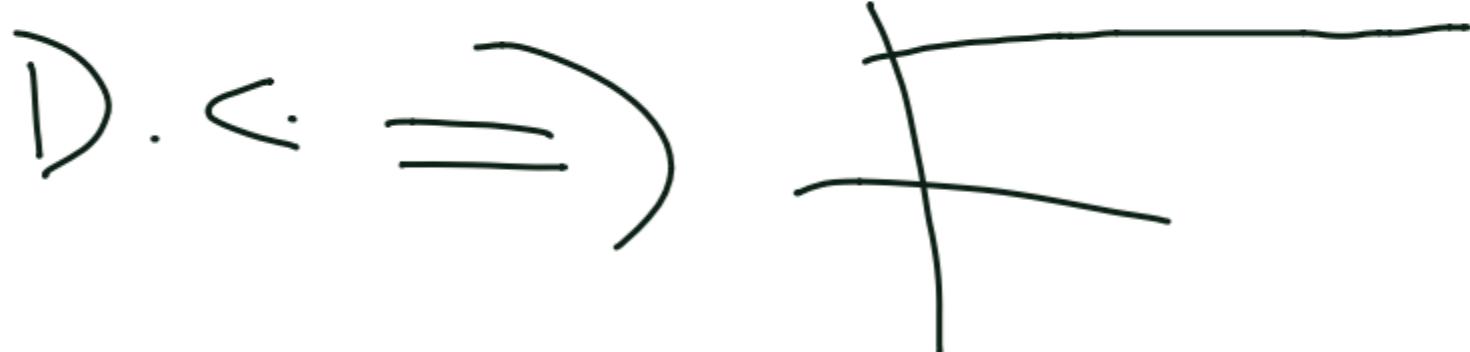
## Power Protection

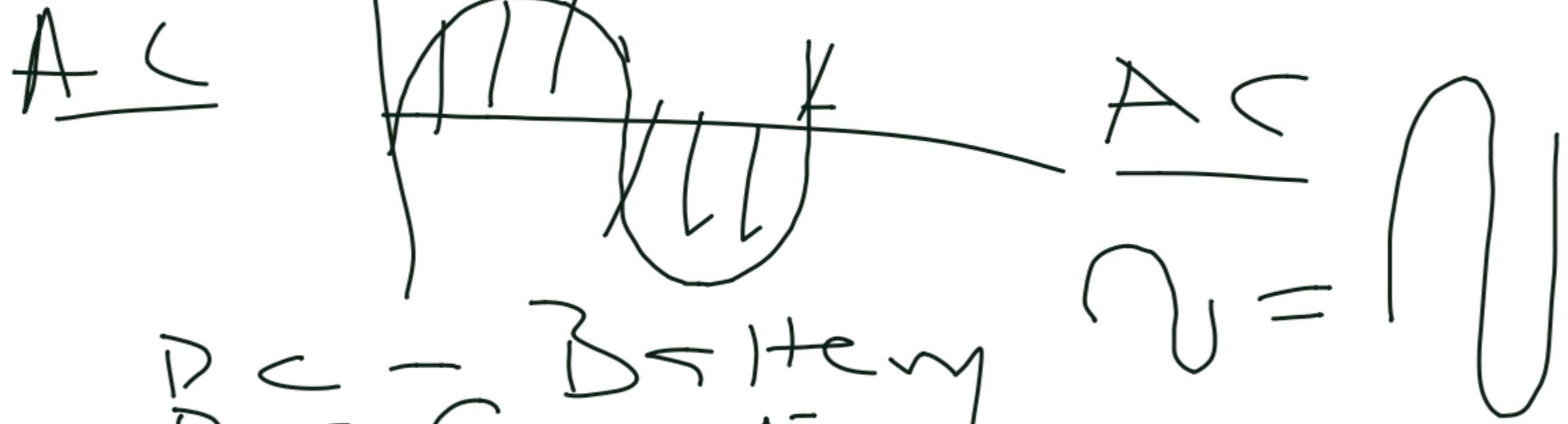
AC - Alternating Current.

DC - Direct Current.

DC - Generators.

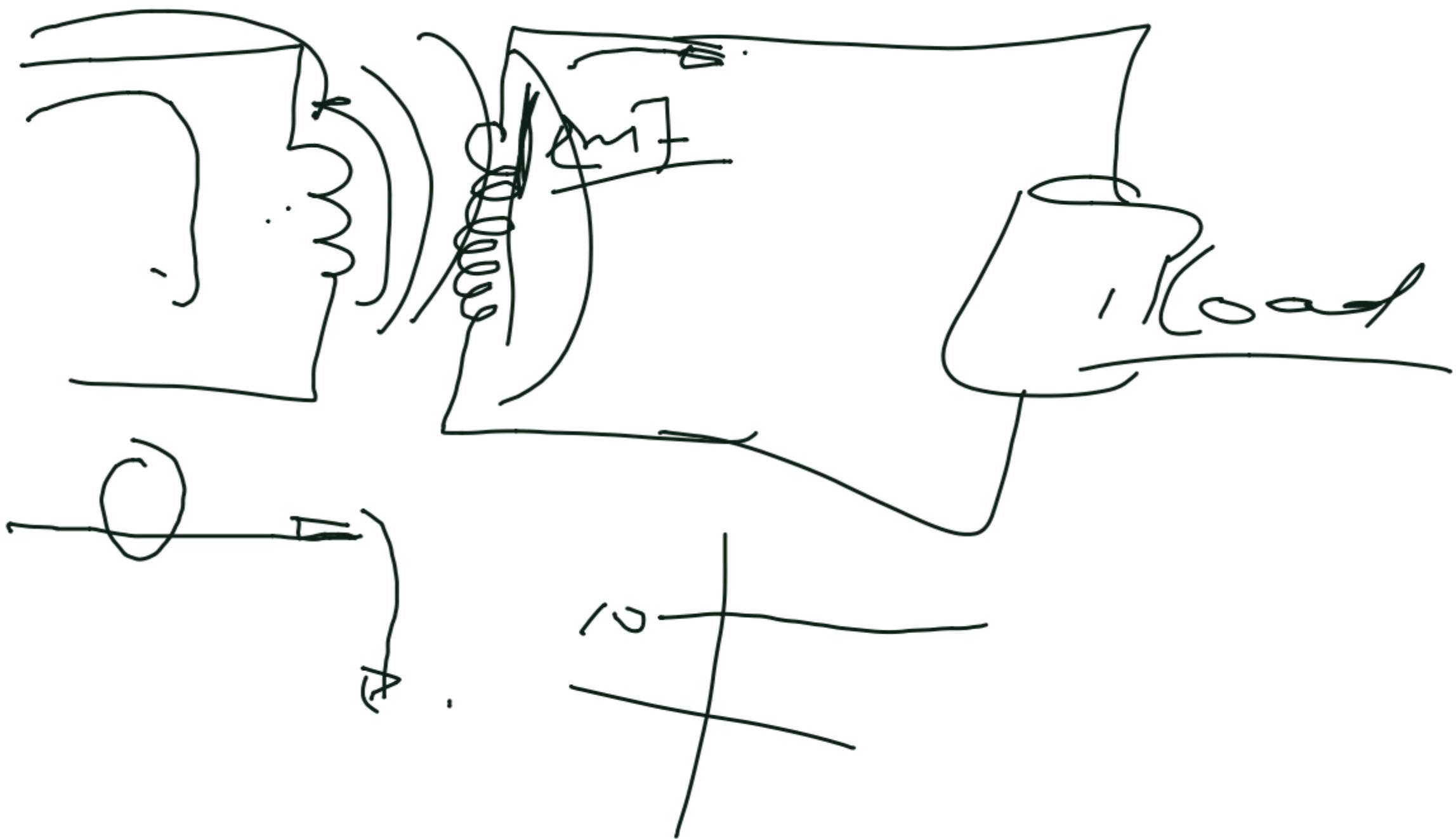
AC - Alternating





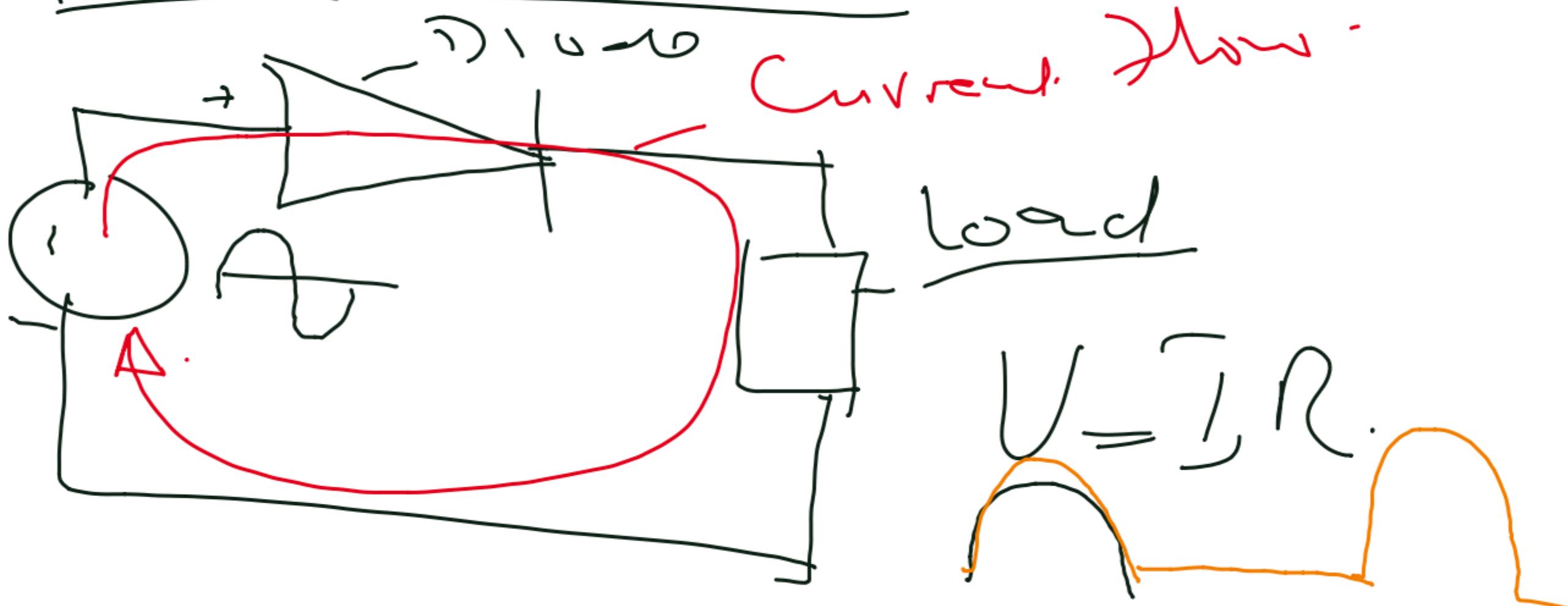
D.C - Battery  
C.Generating  
Conv. - D.C.

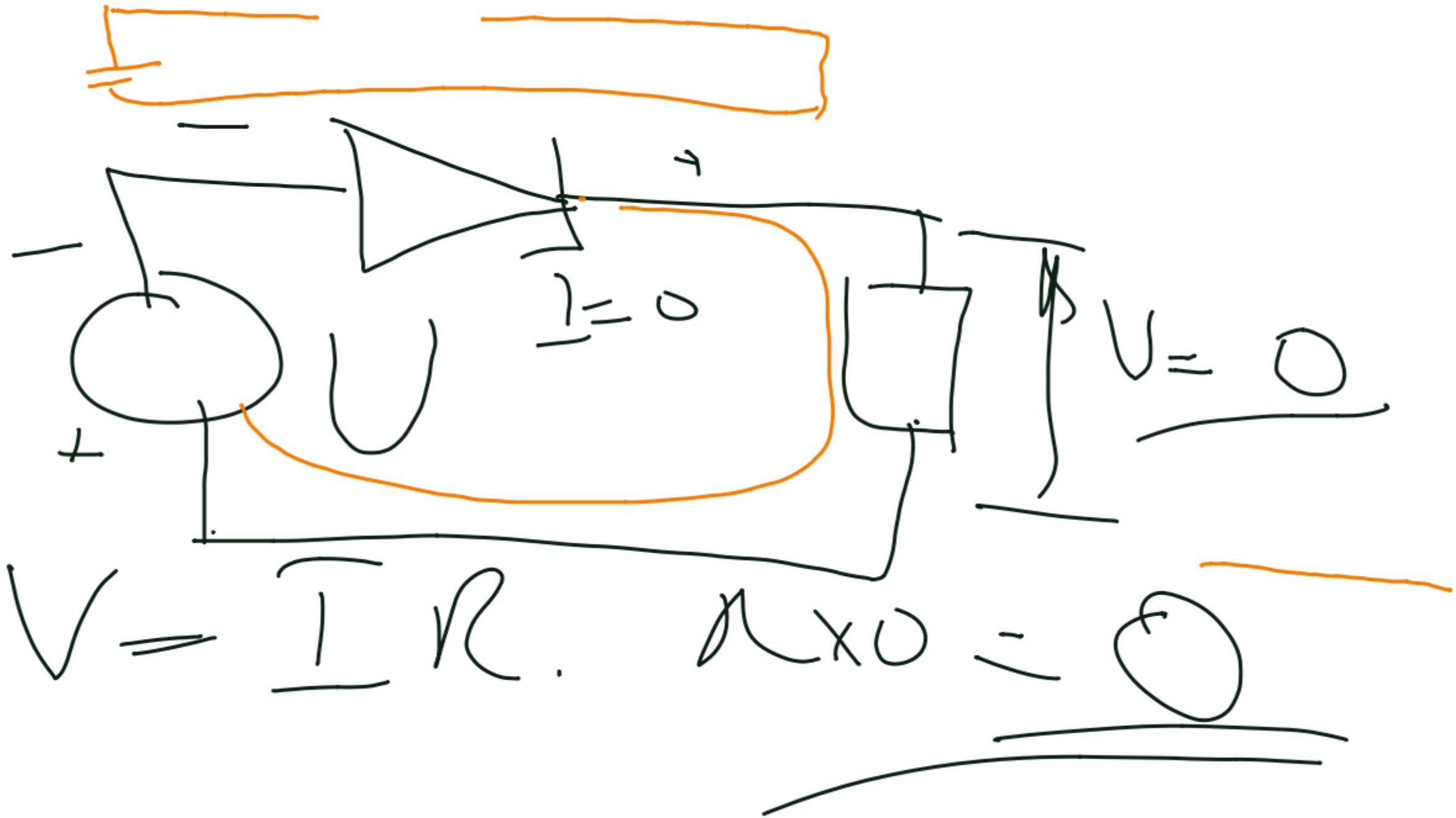


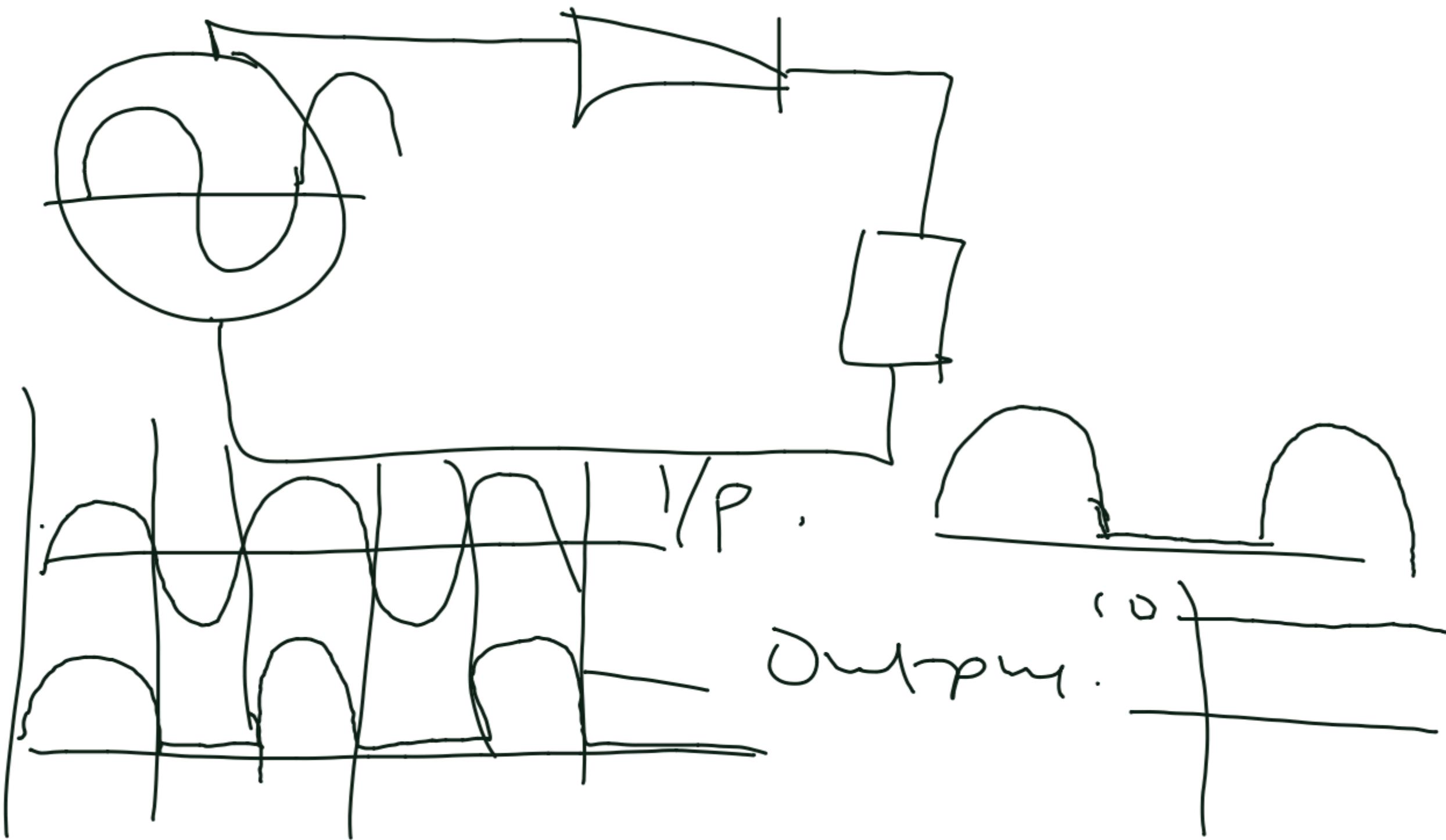


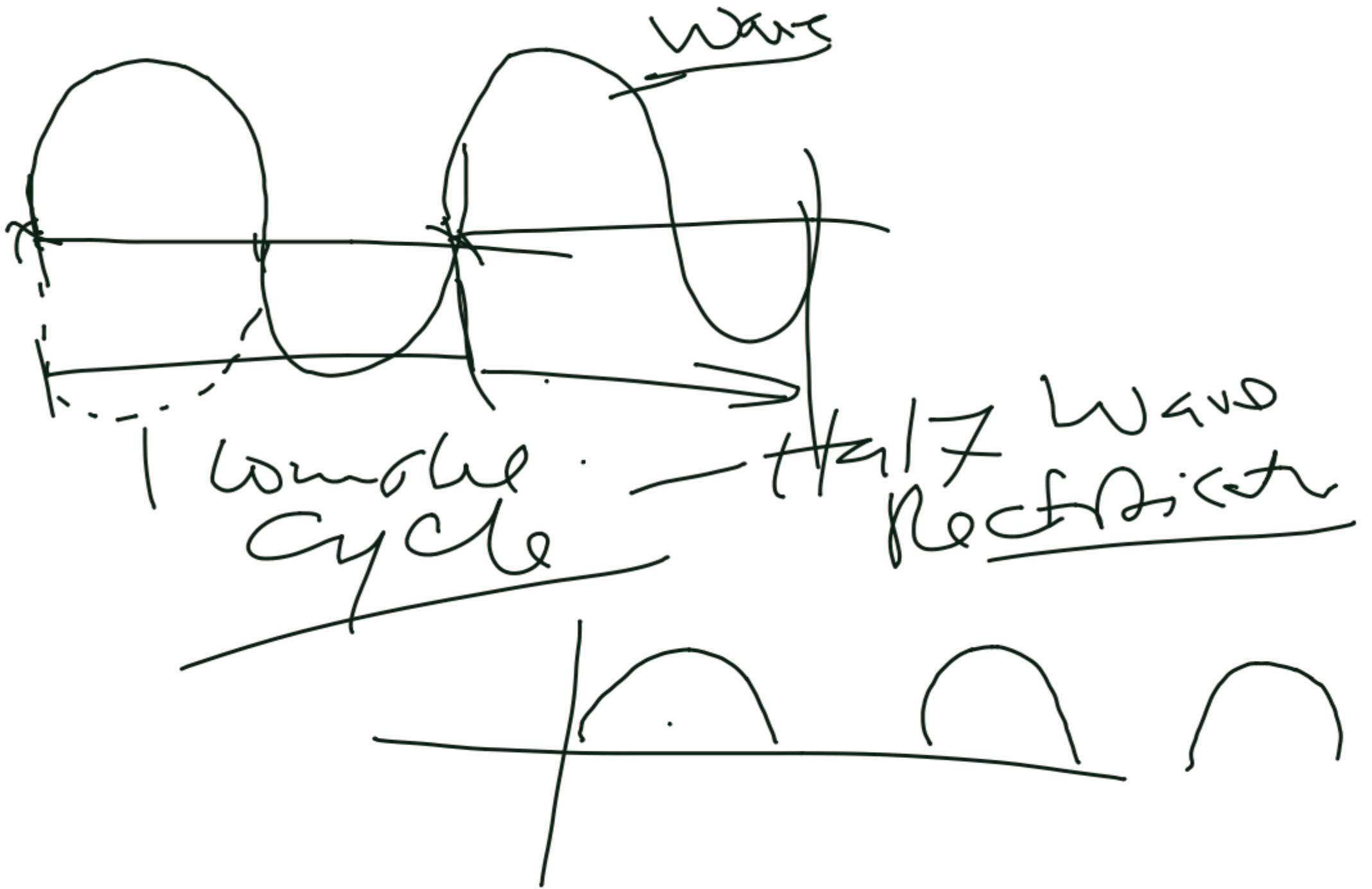
# AC to DC conversion

## Rectification:

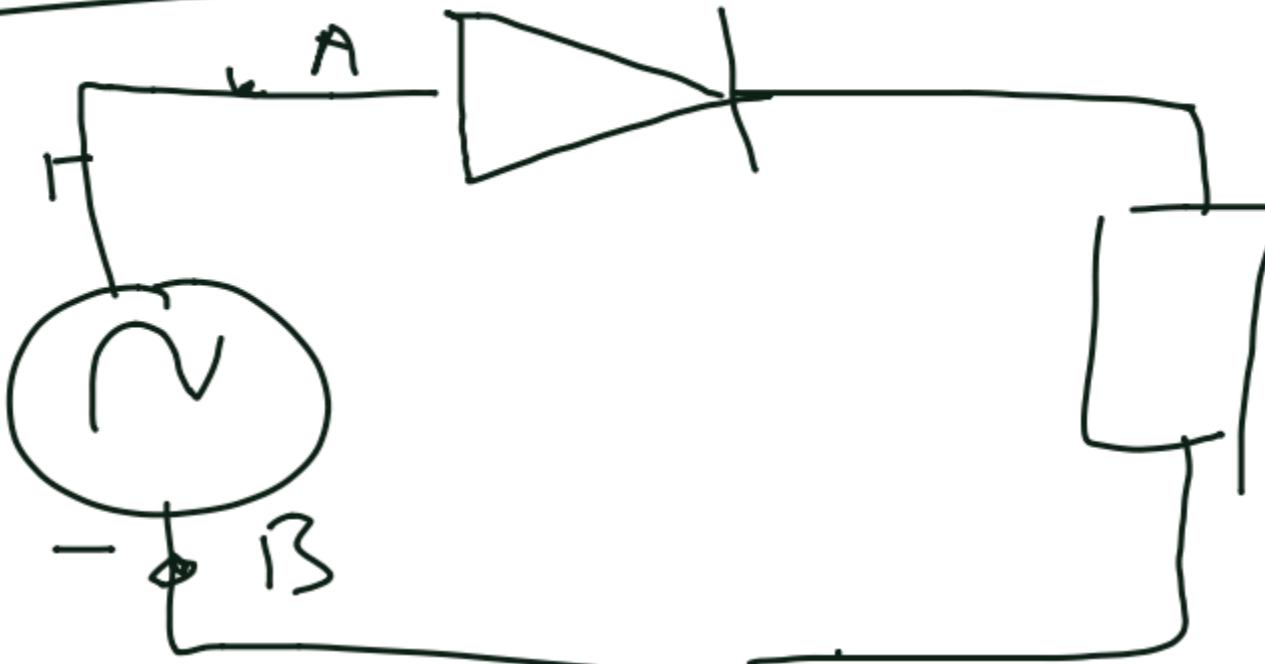








## Diode Rectifier

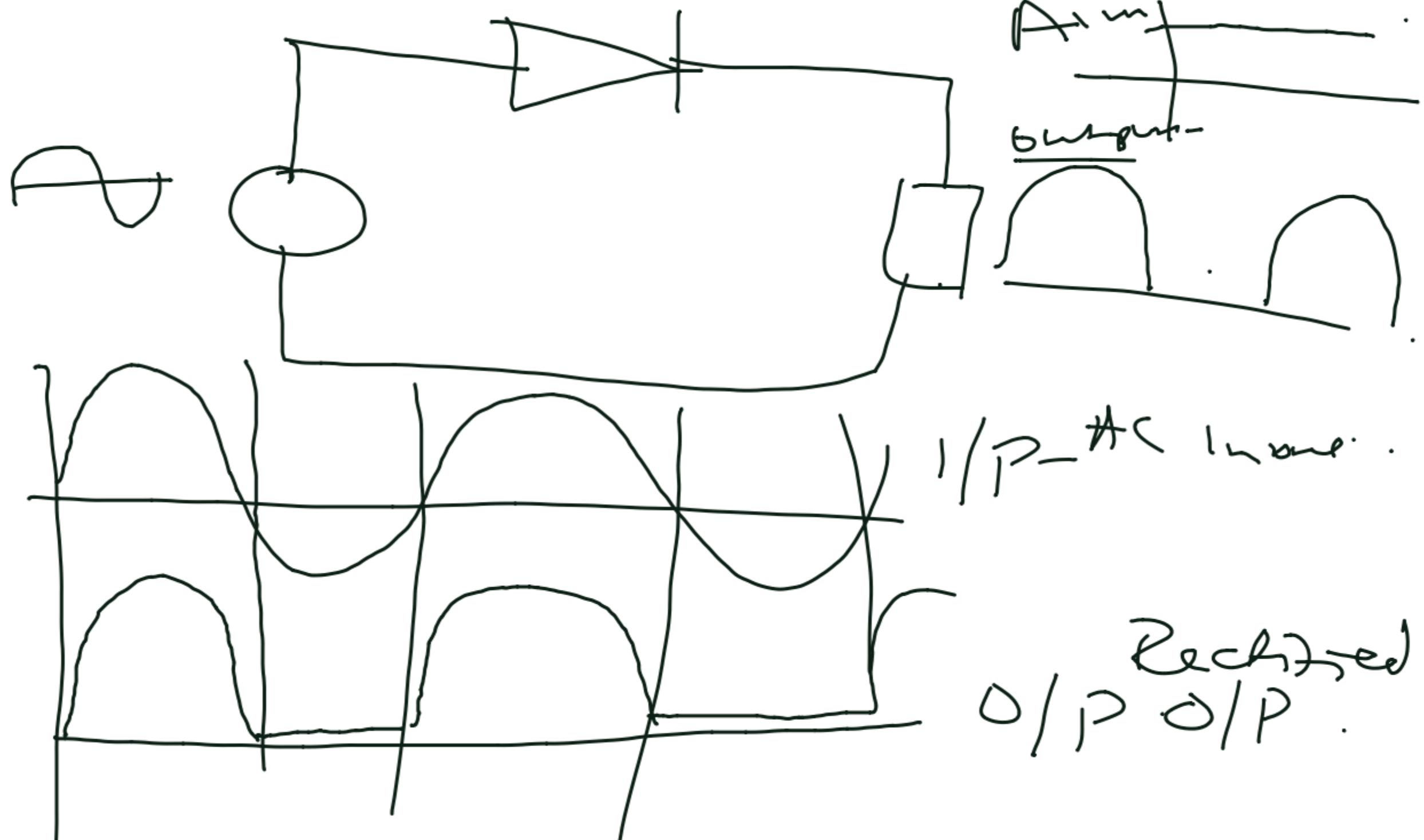


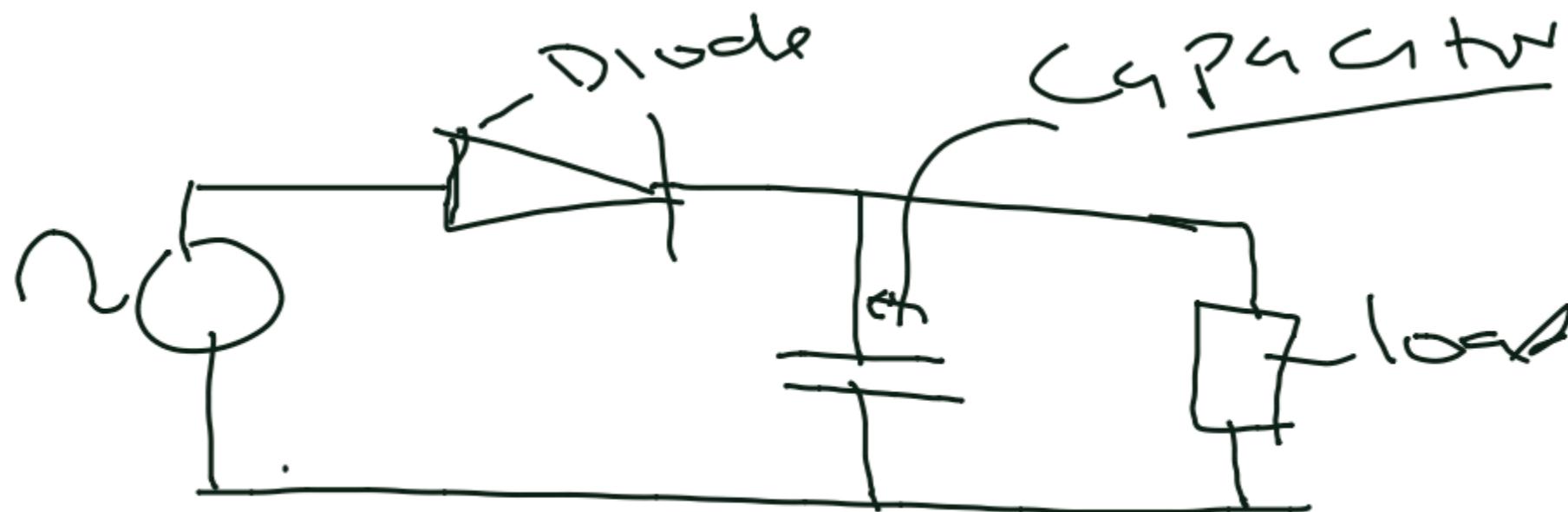
When an AC signal is applied at the input of the circuit shown if point A is positive with respect to point B the diode is forward biased.

With the Diode forward biased  
current will flow from point.

A to Point B through  
the Diode and the load  
resistor. Across the load  
resistor is voltage approximated  
equal to the input voltage  
is developed.

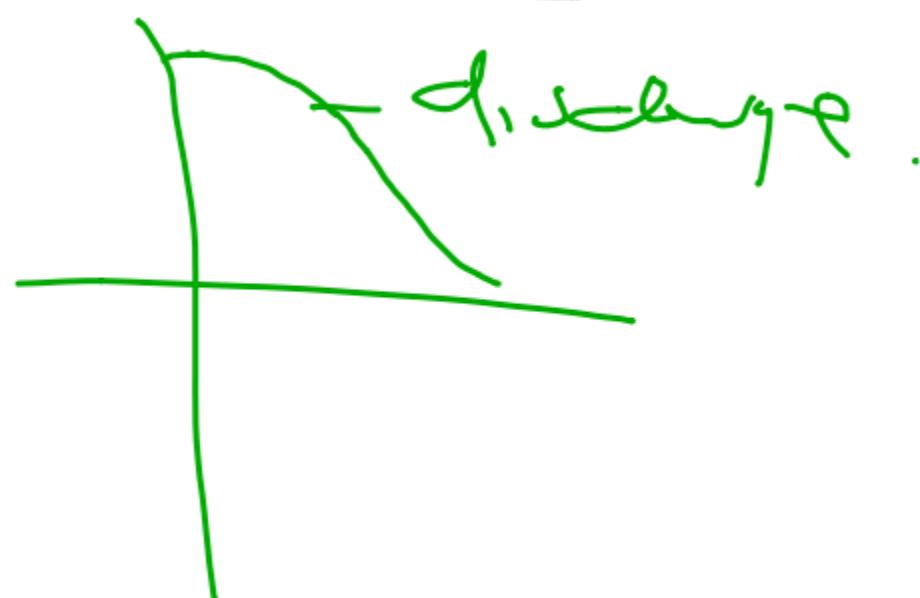
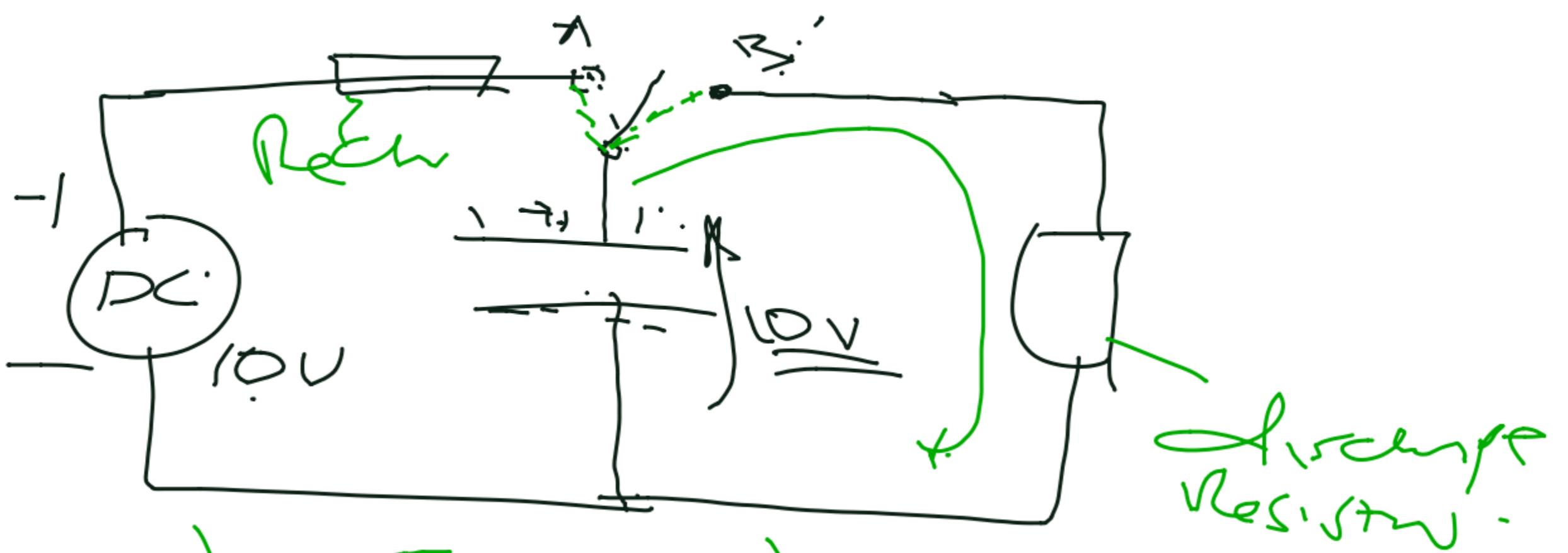






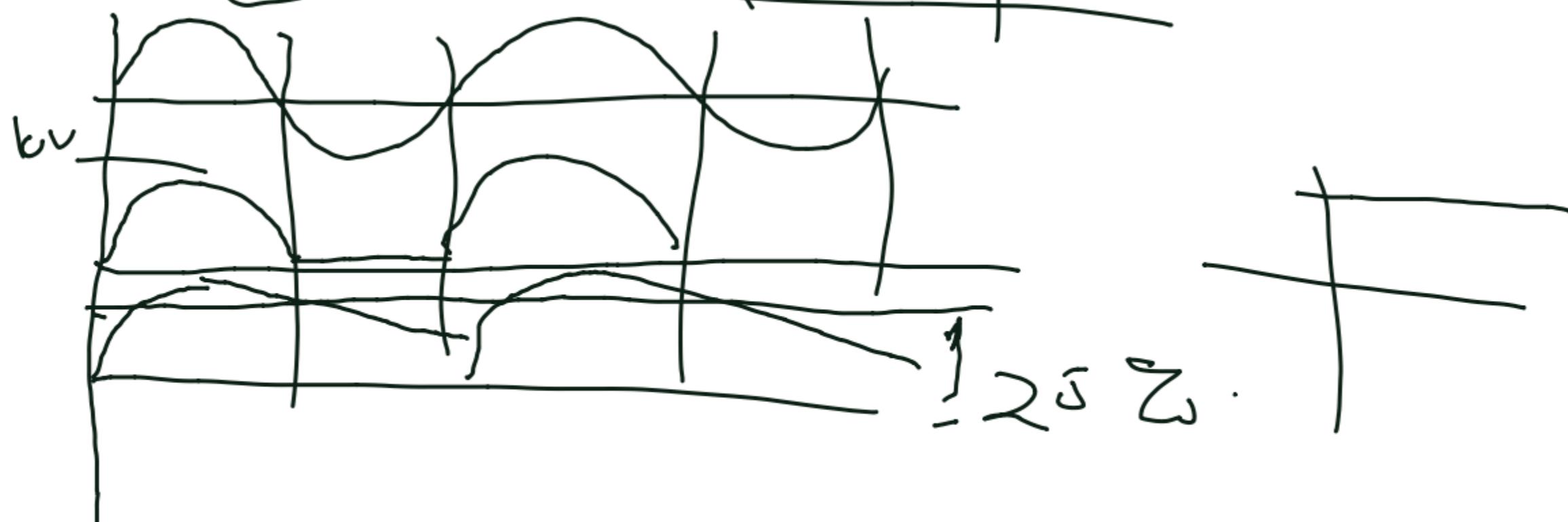
## Capacitor

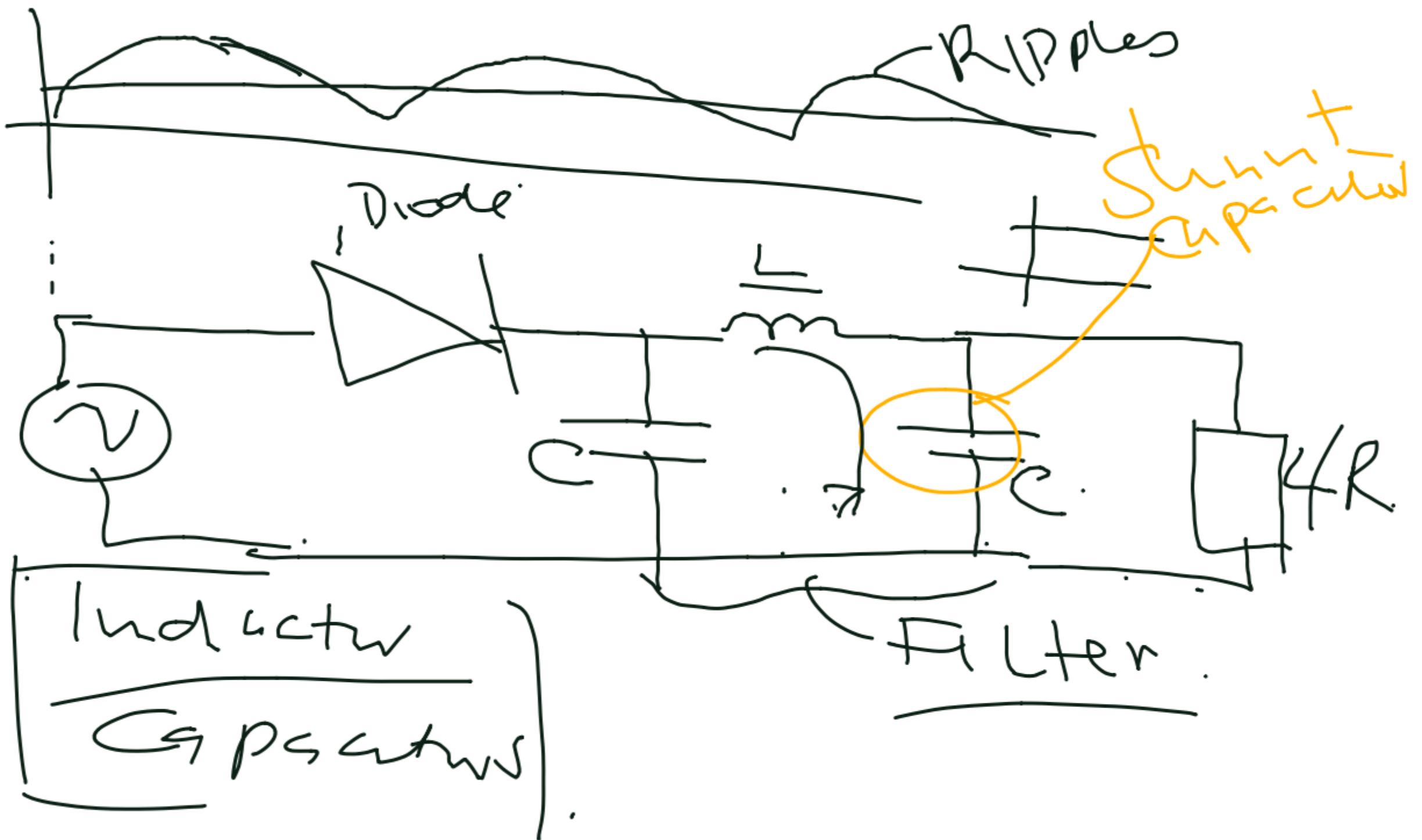
Electrical Components Their  
has the ability to store  
electrical energy in form of  
electrical charges.  
The unit of measuring its capacity  
is known as FRENCH.

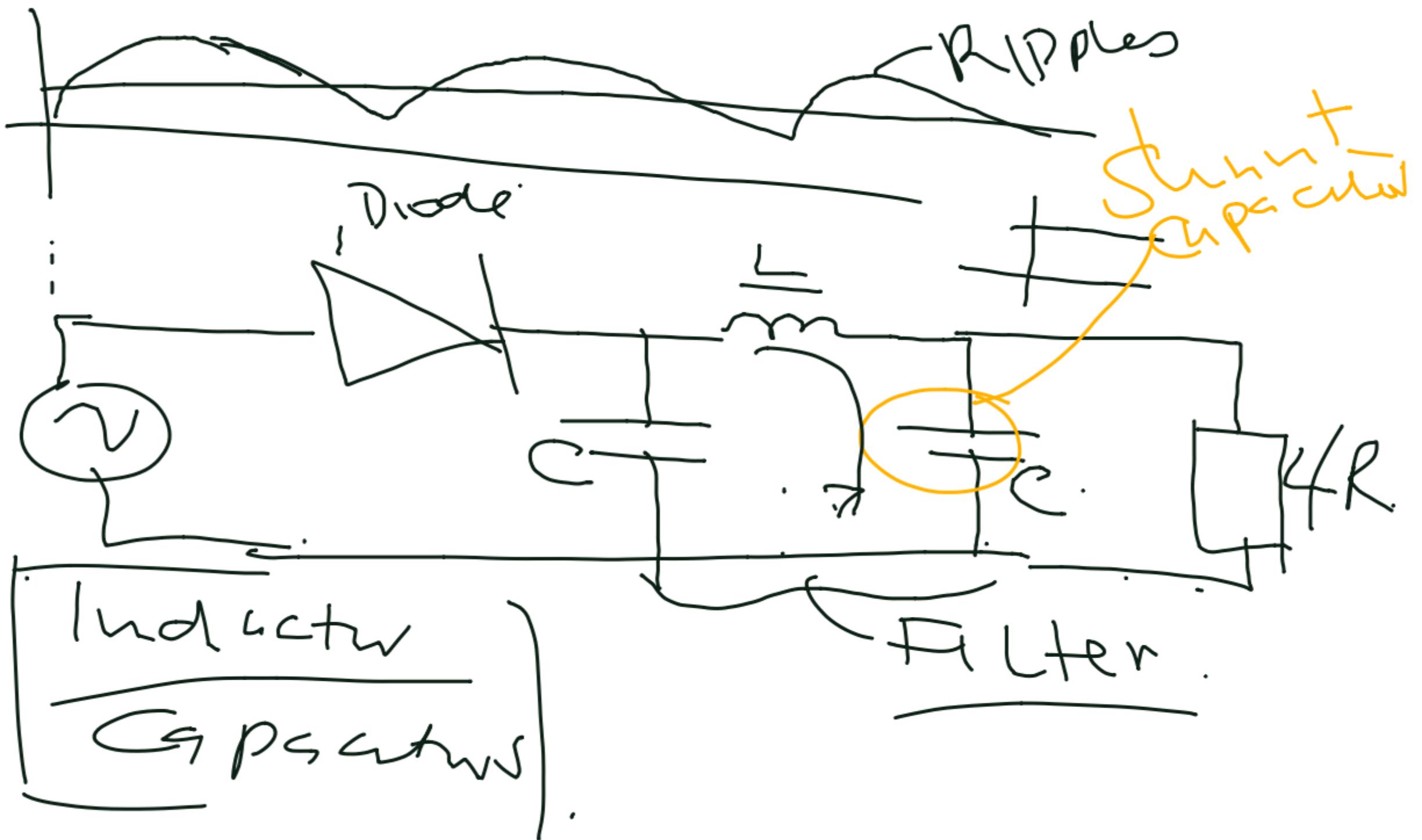




Reservoir  
Capacitor  
Modifying  
Capacitor









$$D.C. \text{ Syr} = \frac{10V}{\text{---}} \times X = \frac{10V}{\cancel{2\pi f} \times \cancel{C}} = \frac{10V}{2\pi f C}$$

~~$\cancel{C} = \frac{1}{2\pi f C}$~~

Fermi's  
Frequency

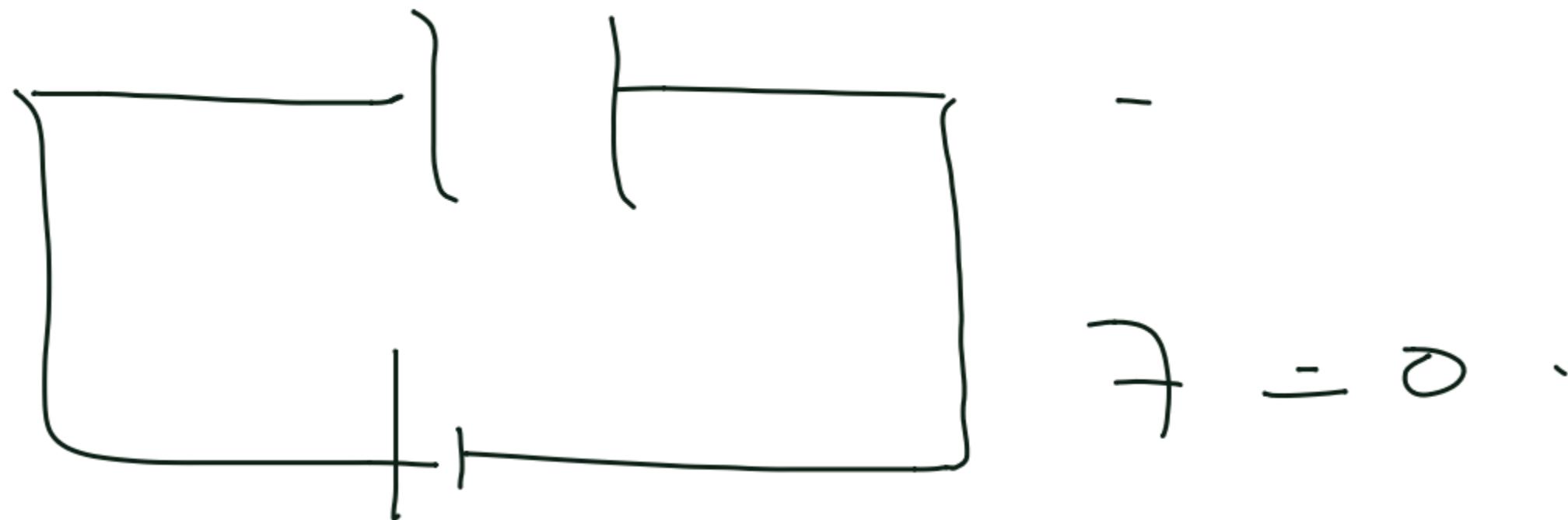
$$\dot{\theta} = \frac{1}{T}$$



$$y_{T_p} = \theta$$

$D_C$

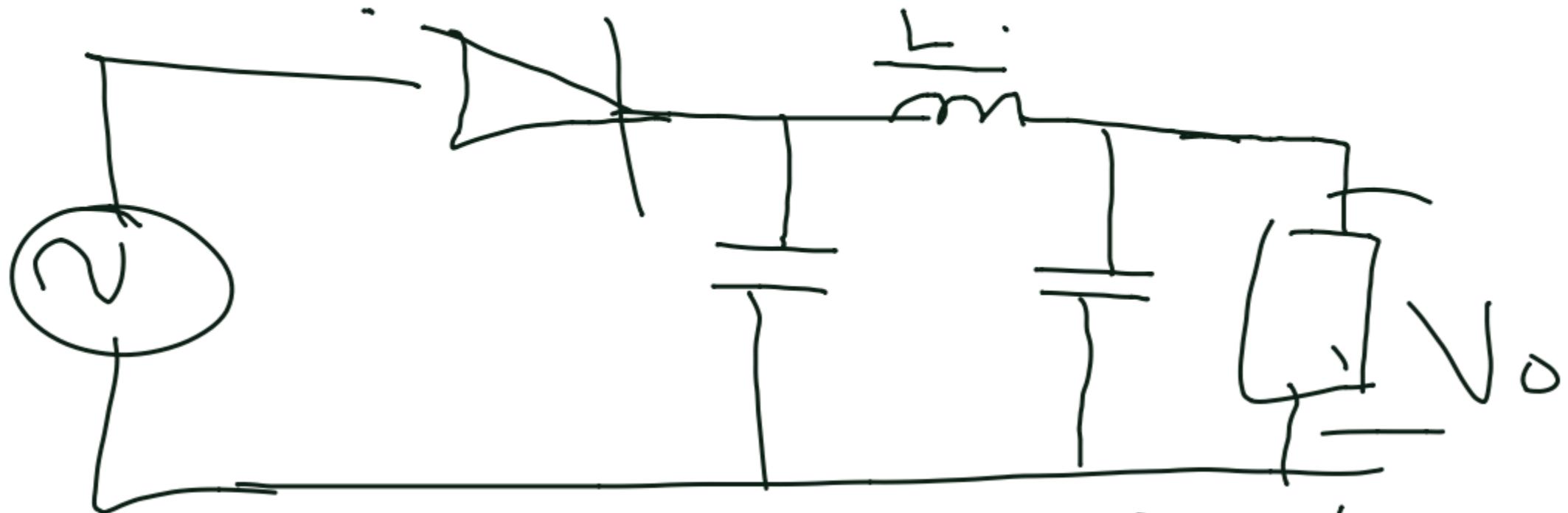




$$V_c = \pi r^2 h$$

$$V_c = \cancel{\pi} \times 3.142 \times 0 \times \cancel{h} = \frac{1}{\cancel{\pi}} \cdot \cancel{3.142} \cdot \cancel{0} \cdot \cancel{h}$$

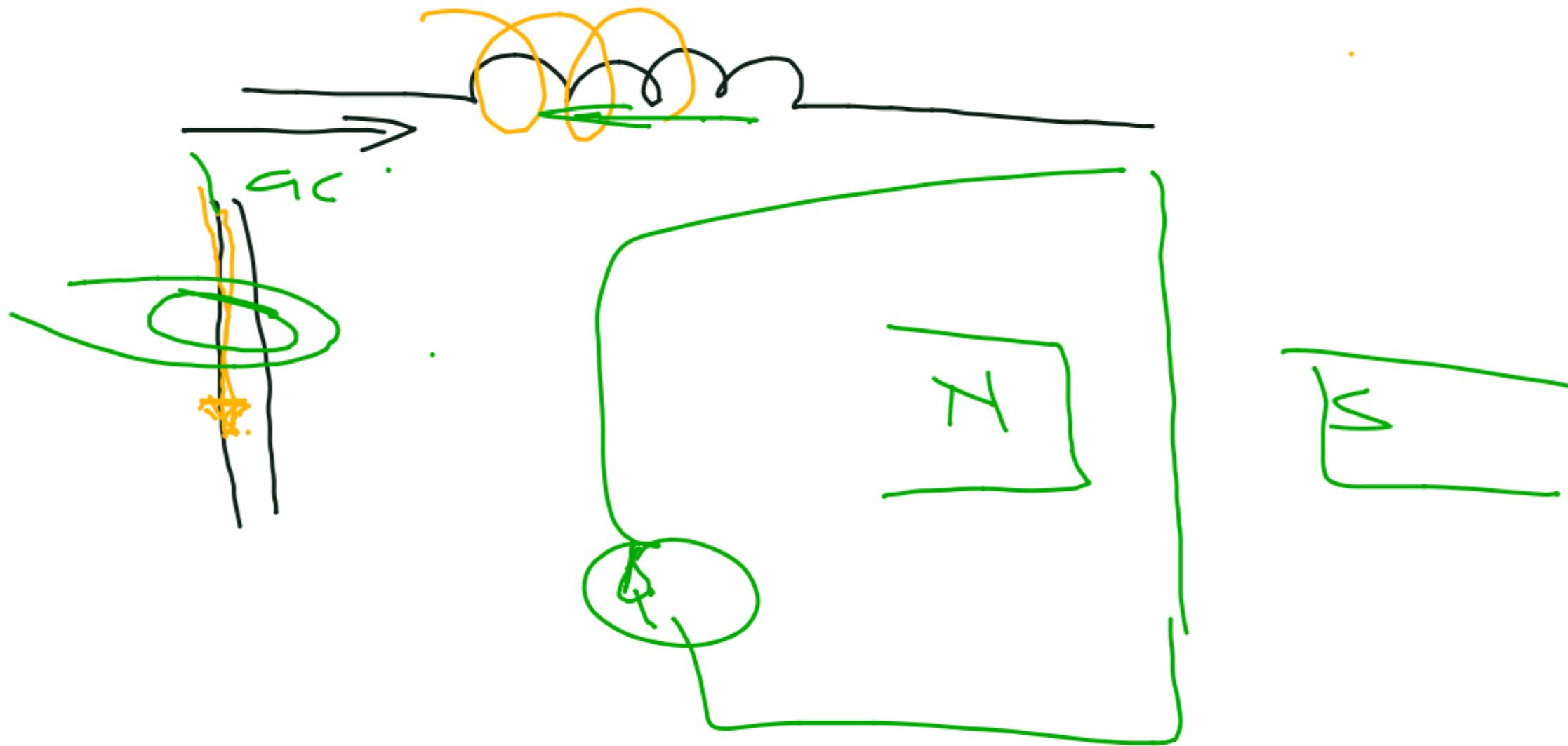
$$\begin{aligned}
 X_c &= \frac{2\pi f c}{\lambda} \\
 &= \frac{2 \times 3.142 \times 50 \times 10^6}{2 \times 3.142 \times 50 \times 10^{-2}} \text{ cm} \\
 &= \frac{31.42}{318.27} = \underline{\underline{1000 \text{ cm}}}
 \end{aligned}$$

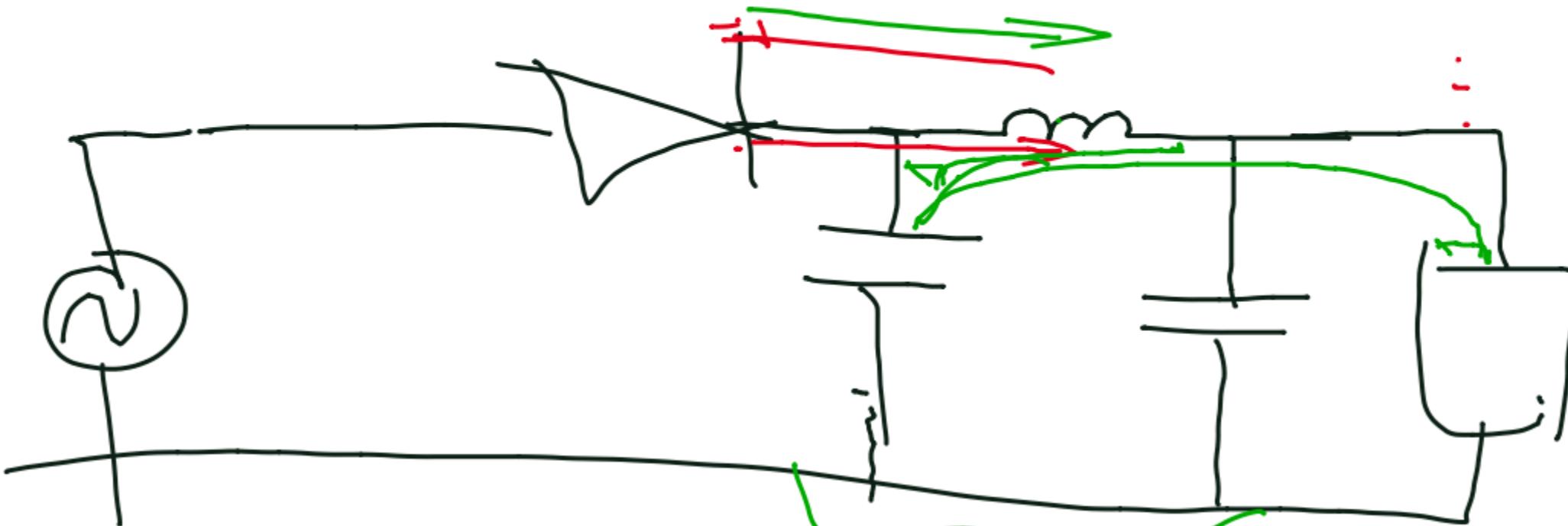


The shunt capacitor will short circuit

$V_o$  line ac signal  
to the ground  
blocking the dc.

Self Induktion





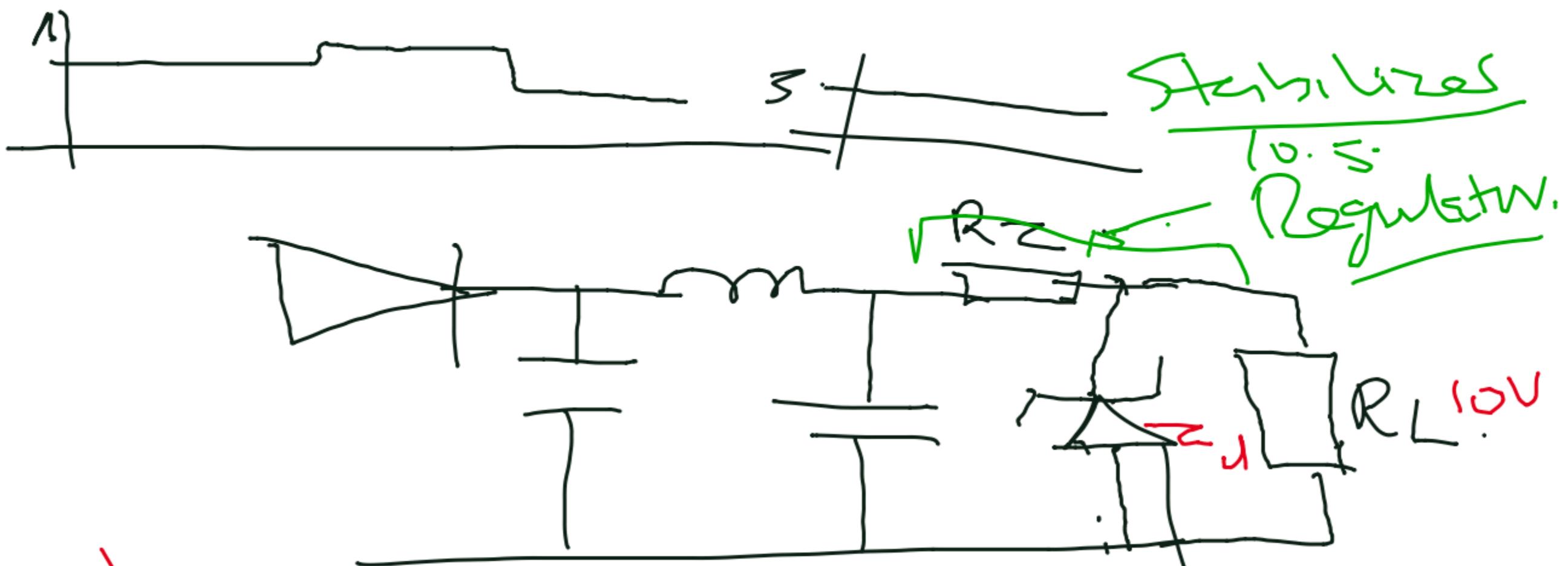
+V<sub>0</sub>

Filter  
Circuit -



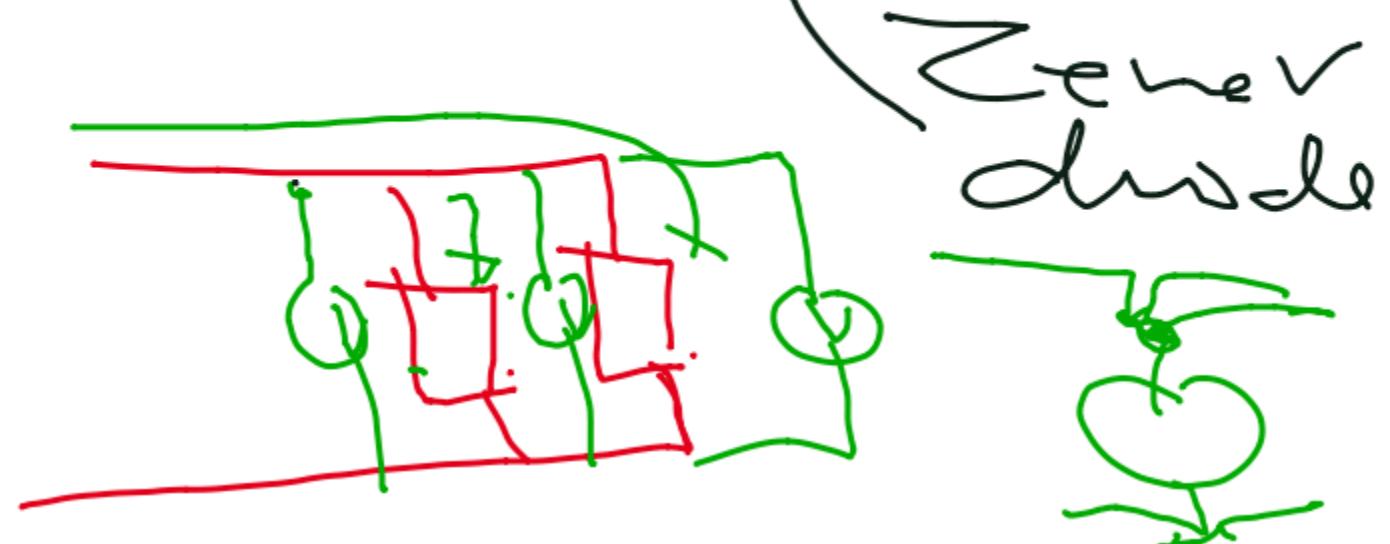
Pi - Filter .

The Engine Guard  
will remove the  
G.C. n Poles when  
would ride on top of  
the D.C. Signal upon the  
rectification of a C. Signal.  
The Shunt capacity will  
allow the G.C. Signal to be blocked  
shunted to ground but Books  
the d.c. go as to reach  
the wad.



$$V_Z = 10V$$

$$V_A = I_A R_A$$

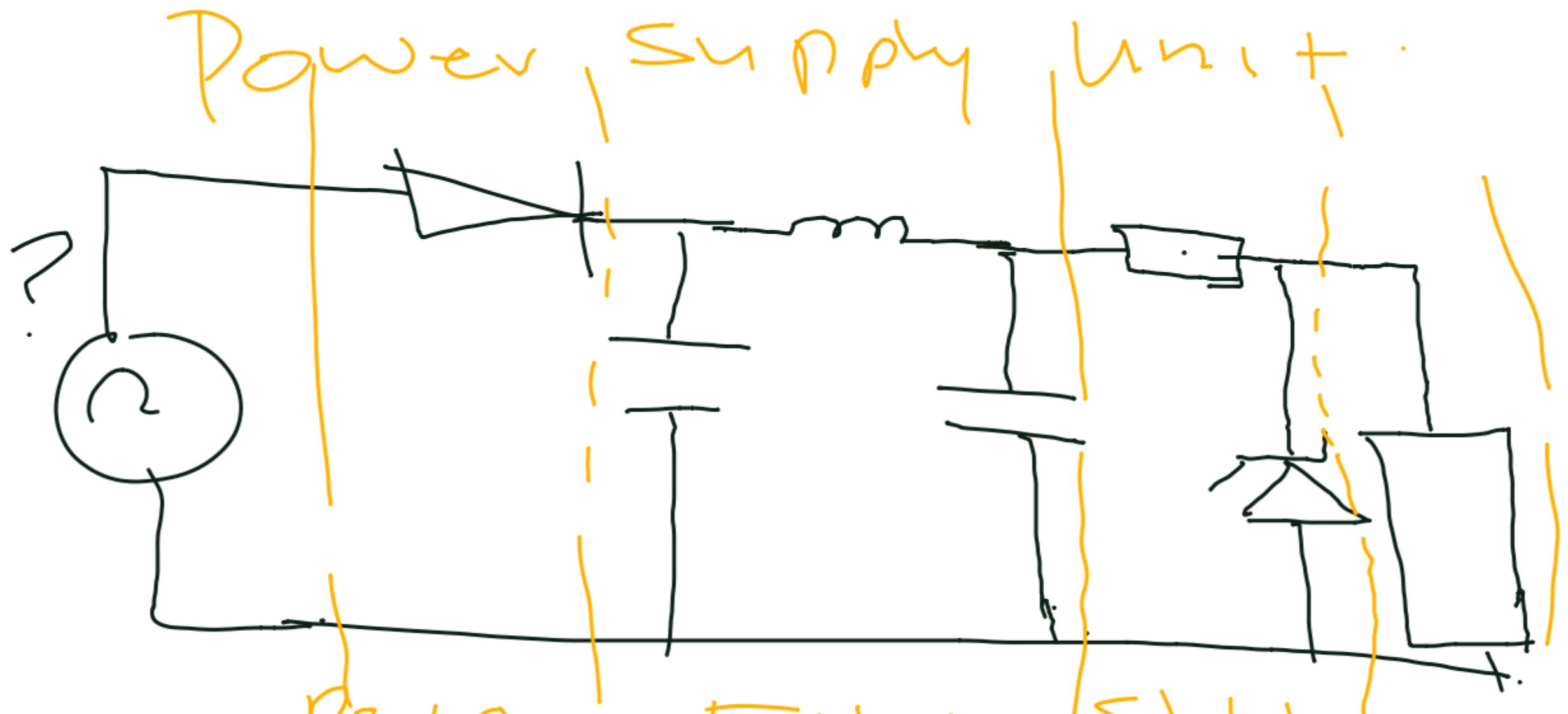




I<sub>L</sub>

$$\frac{I_L \times R_L = V_0}{10V}$$

$$V = \frac{10V \cdot 0.5}{10.5V} = 0.476V$$

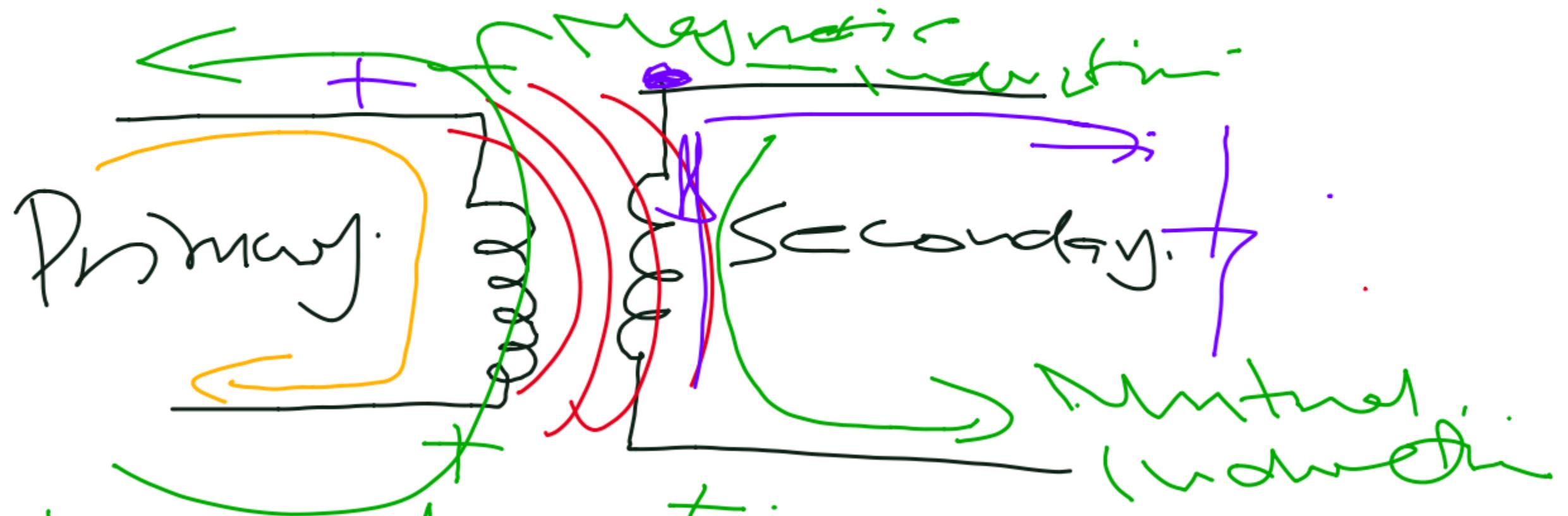


Power Supply Unit  
 Rectifier - Filter  
 STABILISED P. S.  
 Stabiliser /  
 Regulator. Load

With the Zener diode  
connected in the  
reverse Bias condition,  
the Voltage across it will  
be as per its Voltage Rating  
(I.R.) if the Ratio is 10U  
The Output Voltage & Input  
Current will be Fixed at 10U.  
For the output current to be constant  
with the constant load resistor.

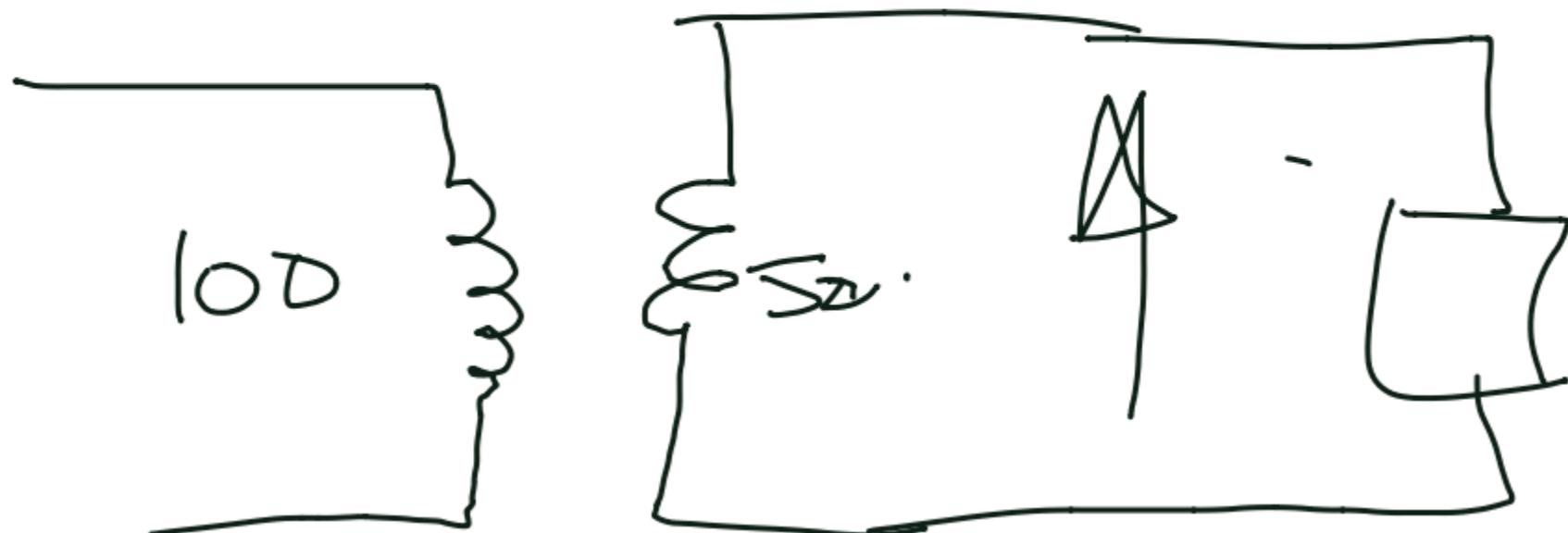
The increase in the  
Input Voltage which  
Results in increased  
Current Curve will be  
taken care of by the  
Zero Resistor  $R_2$  which  
will drop the excess voltage  
giving the zone much more  $D_{ZV}$   
sensitivity. The voltage across  $I_{SV}$   
will control the excess current.

Thus allowing the  
Ocean current to flow  
through it to the ground.  
hindering the land current.  
at-Contest - In -  
Then  $I_L \times R_L = I_R = 100$   
(Thus contest regulation  
of the Variation at the limit.



Induced Current - is flowing  
Secondary winding  
The Transforms



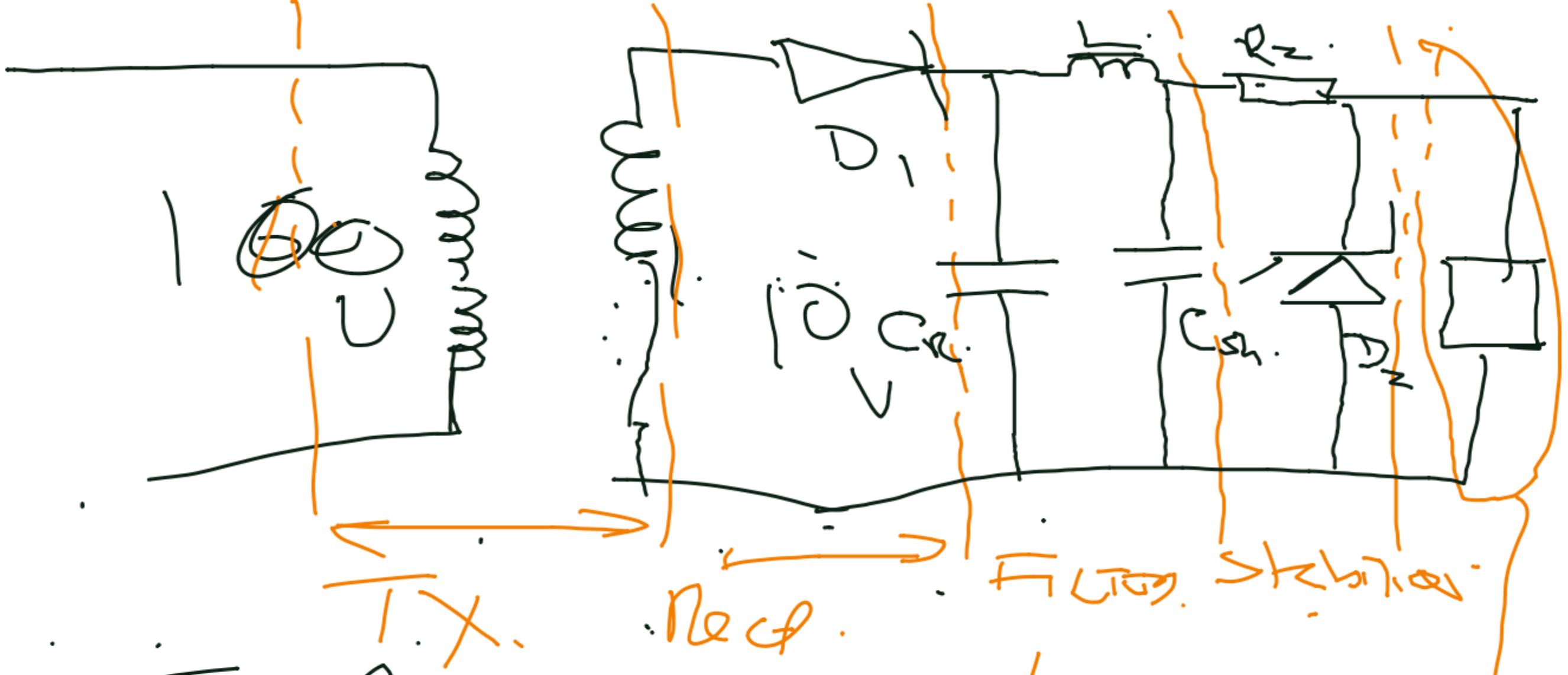


(100V) Step 50V down transformer  
 The Primary Winding is one more  
 than the Secondary Winding.

60

120

Step up transformer  
tie Pooley Windings to  
less than the Secondary  
windings.



The Required Power Supply  
 Unit, factors.

The Power Supply  
Unit is made up of  
Five Functions :-  
Answer -

TX - Transformation  
Changes the Main  
Supply Voltage of say  
240V to the required  
AC voltage of say  
10V.

C Step down - Transistors.

Rect - Rectifier

This changes the  
a-c signal to its  
equivalent sine wave  
in Pulse (Unidirectional)

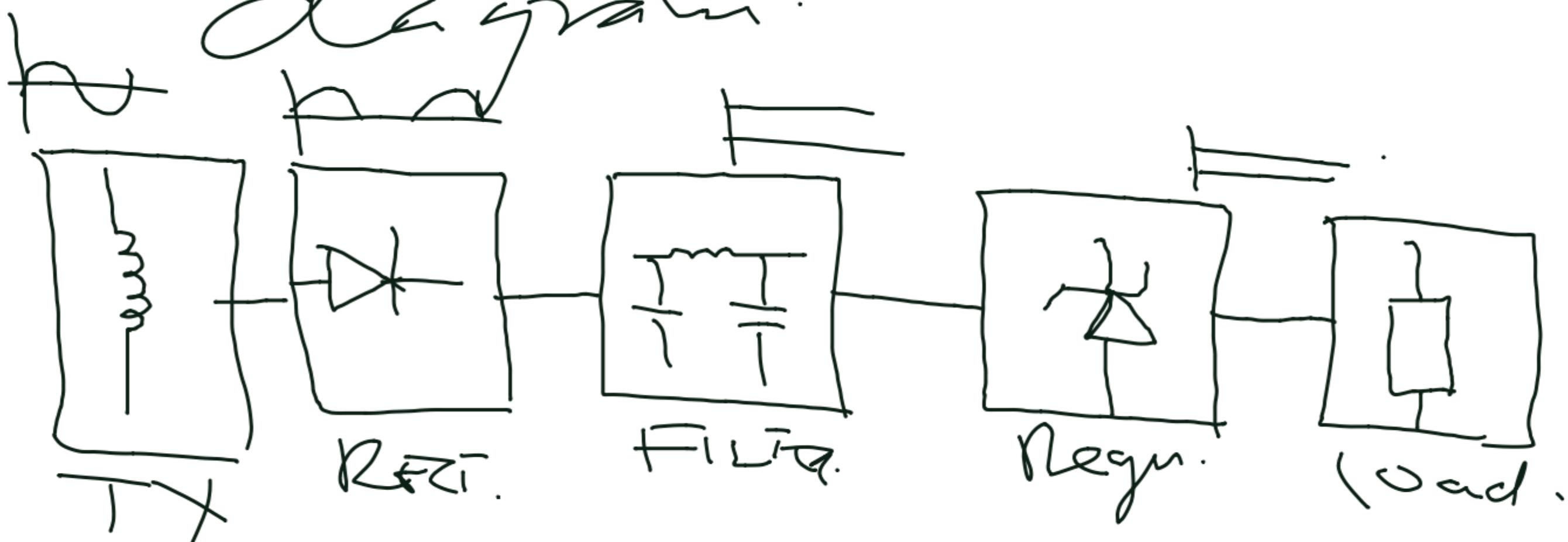
Filter - Filters the A.c Ripples  
that rise on top of two  
a-c signal.

Stabilizer.

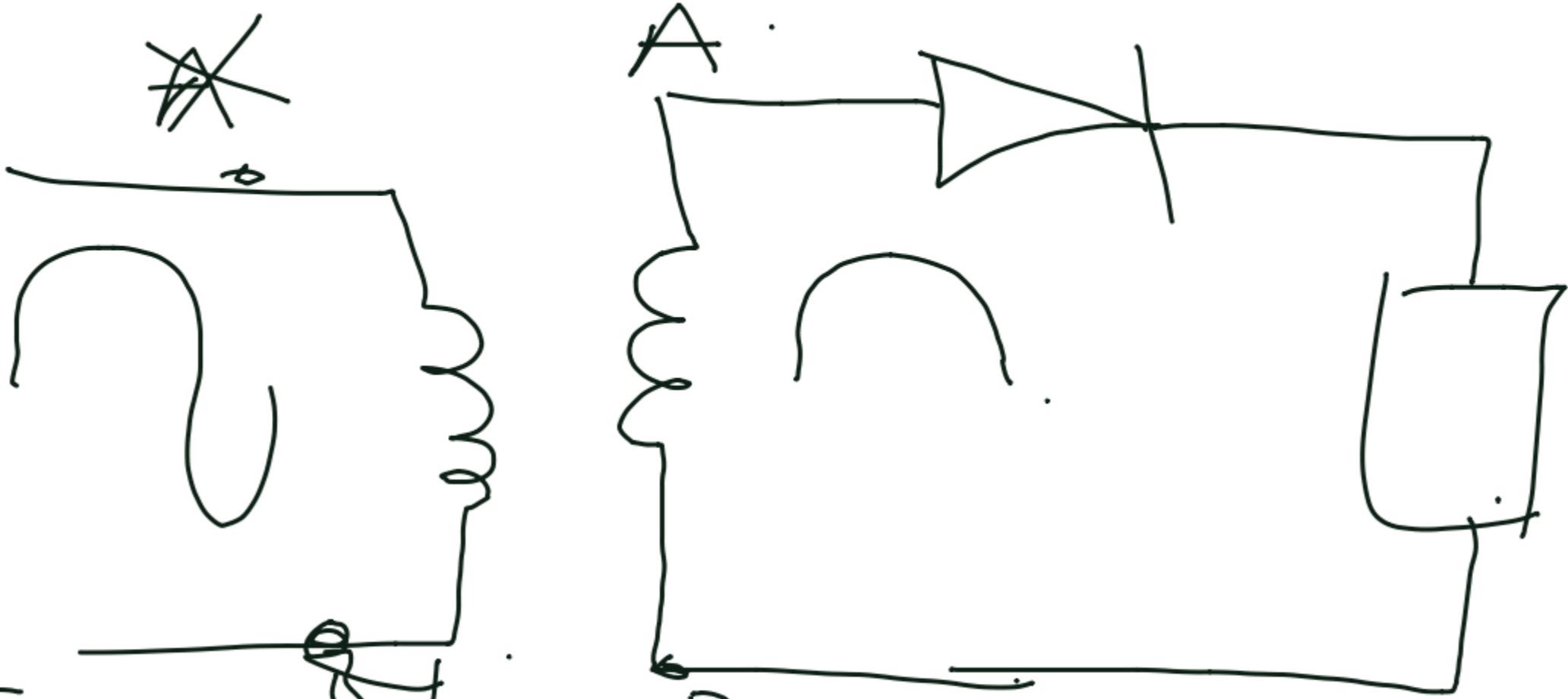
- This will provide  
a constant output  
voltage despite the  
variations in the input  
(stabilized output voltage)

LOAD - The load will consume  
the energy provided by  
the circuit.

P-S.U functional Block  
Diagram.



Block Schematic diagram.

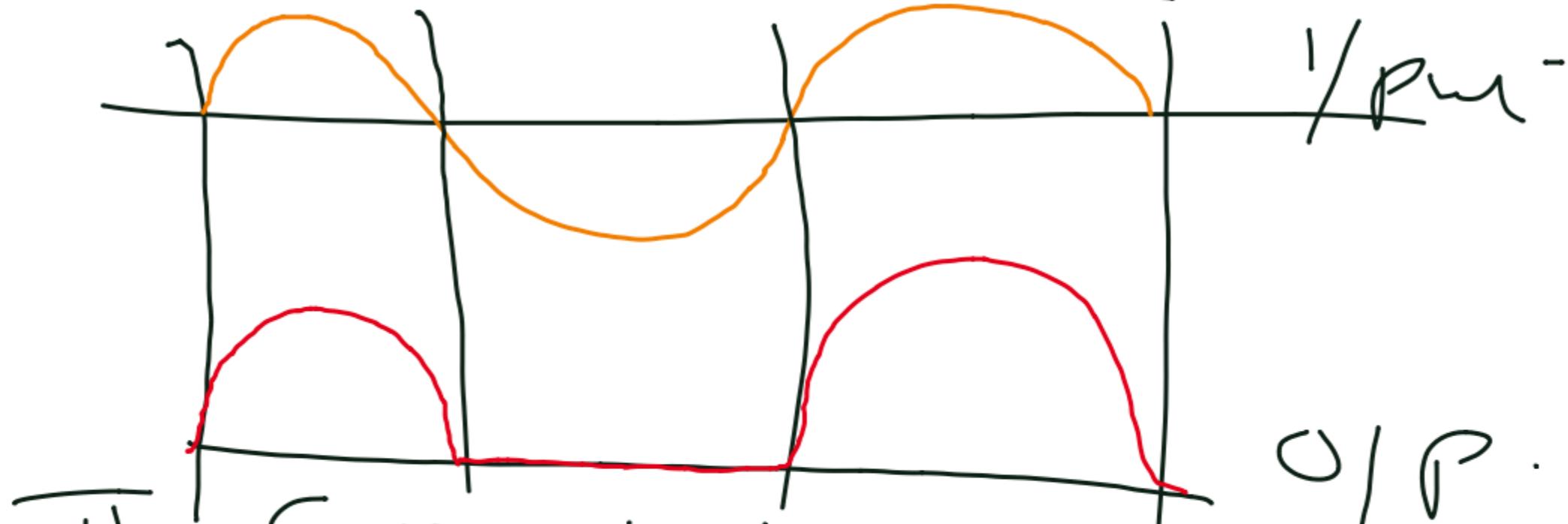


HARFE WAVE = BREKTI, FON.

When Point A is the  
Transmitter is Positive Will  
respect to Point B

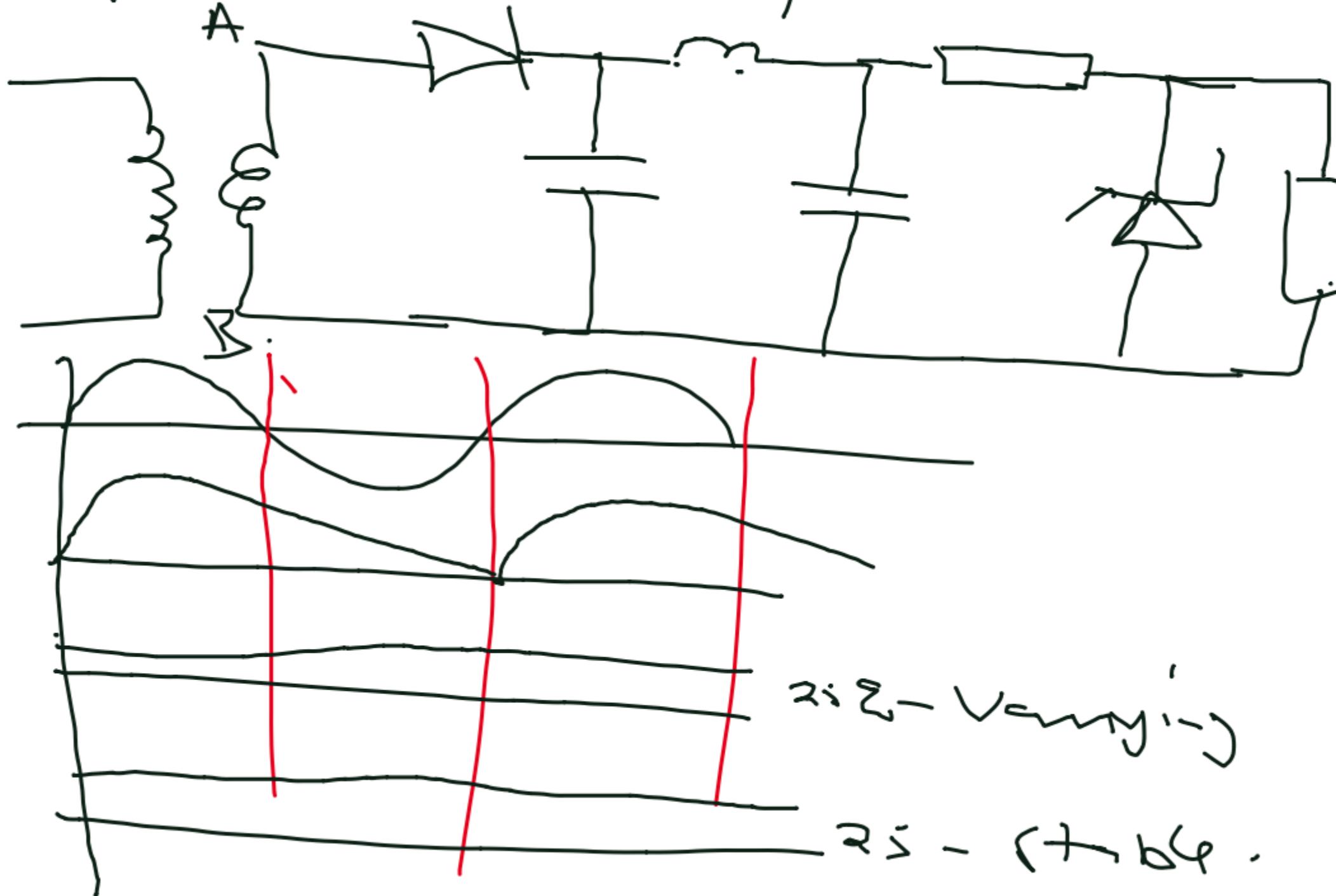
Diode D is forward  
biased. Current =  
flows from A, flowing  
Diode D, to the load resistor  
and back to the Transistor  
P.  
When A is Negative with  
respect to B. The Diode D  
is Reverse Biased.

No Current is  
in the Circuit i.e.  
Voltage across the  
load is zero.



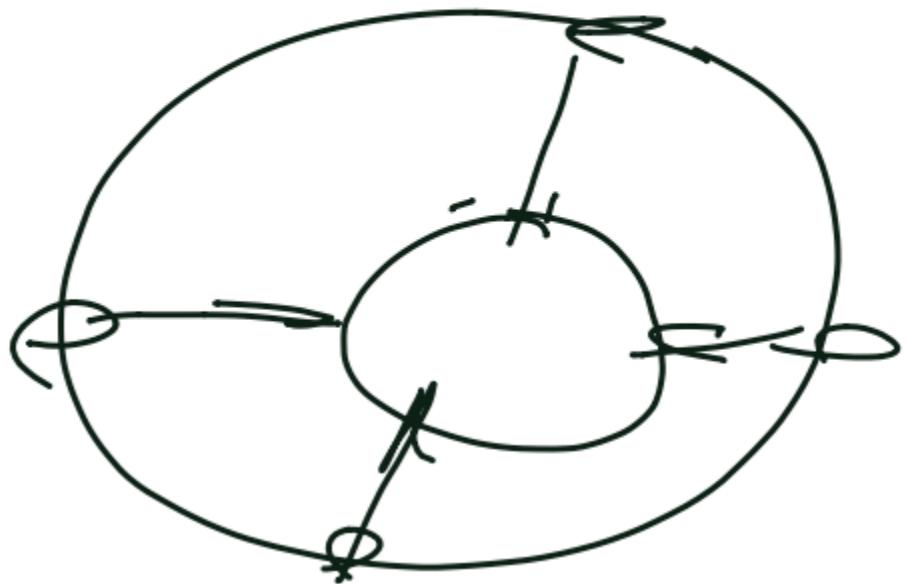
The Circuit is able to receive only  
the Positive half going signal

# Power Supply Unit -



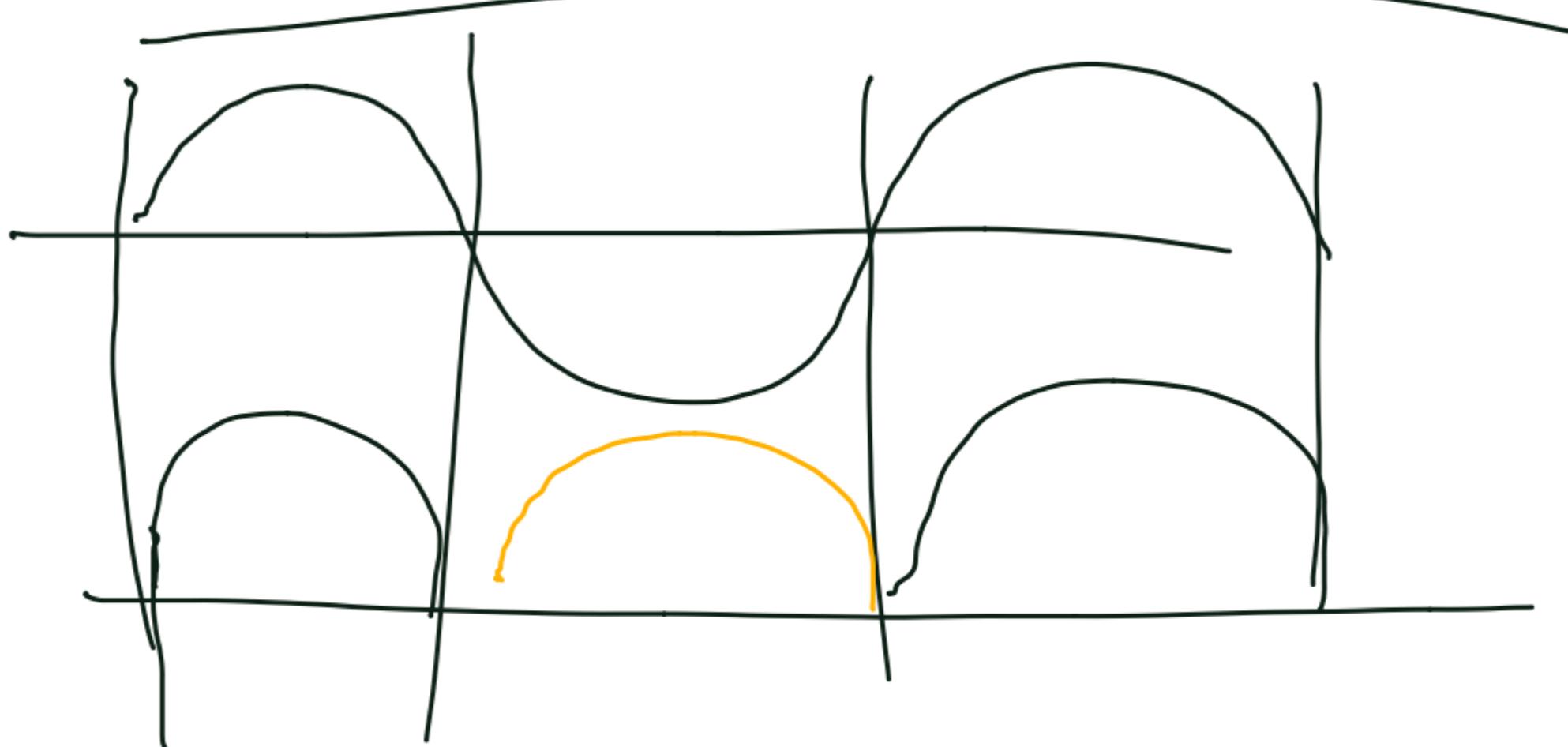
The electrons being  
liberated by heat  
from the Glimmer plate  
will not leave the plate  
for the Vacuum Space.  
The valve they will remain  
attached to the positively charged  
Glimmer plate. Thus  
electrons will be unable to move  
in the Vacuum Space because of their mass.

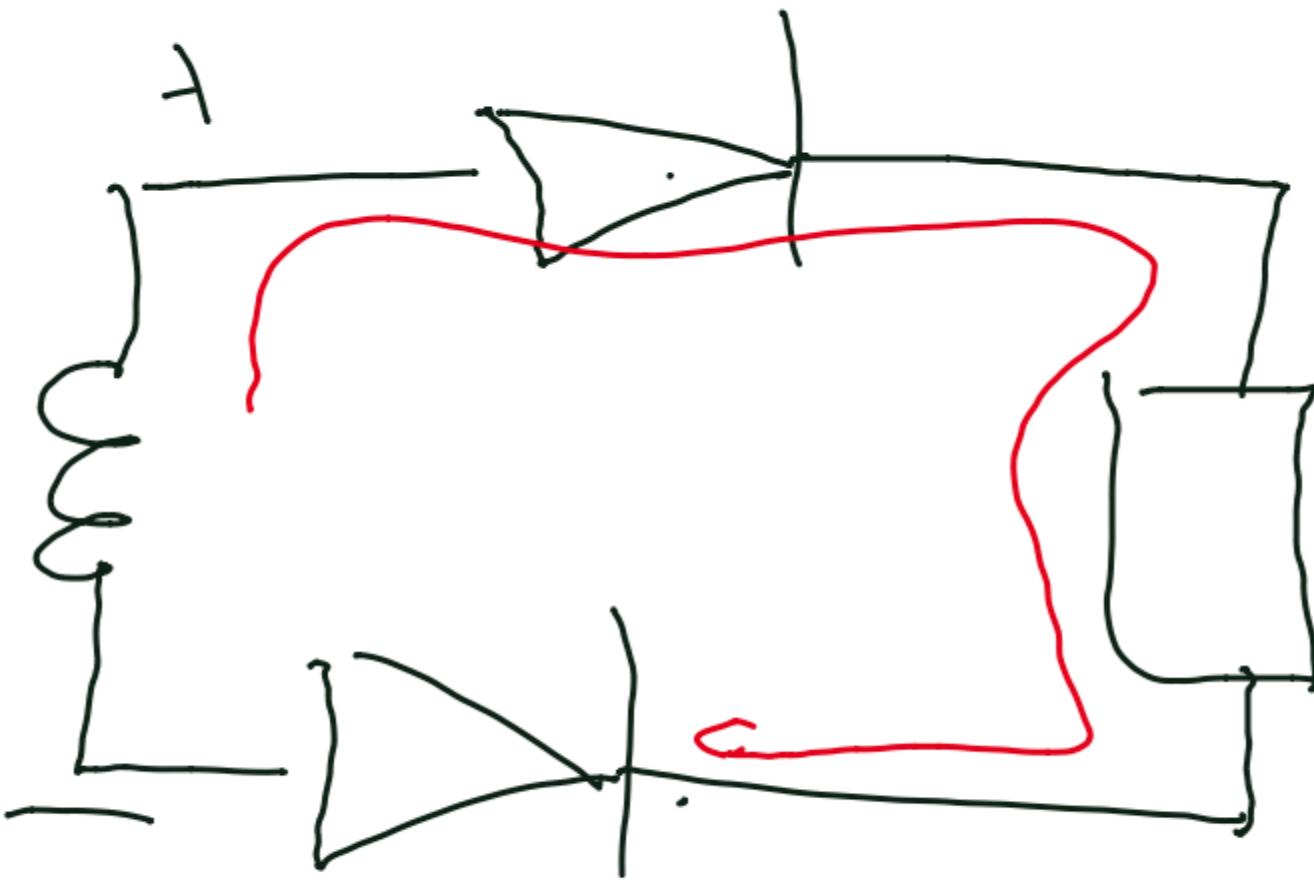
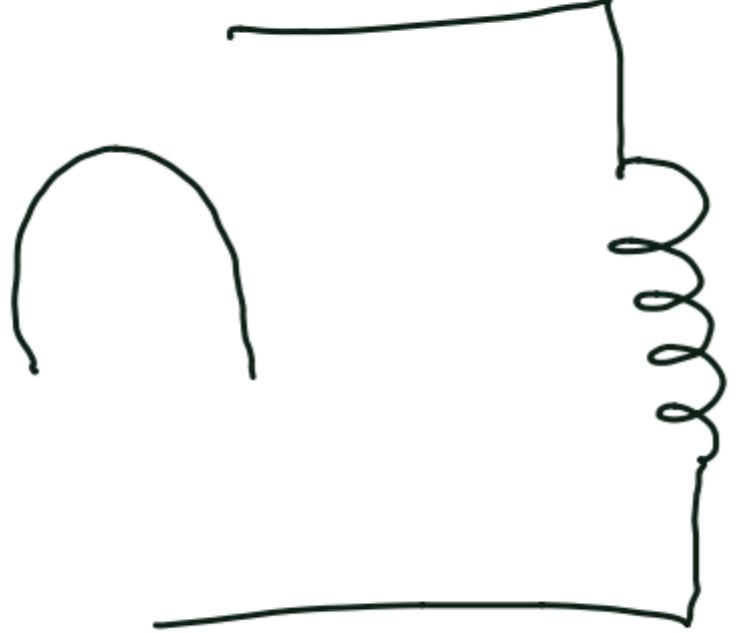
The electrons and holes  
will acquire energy to jump  
the depletion layer (Barrier)  
This movement of charge  
causes will constitute in  
electric current flow.



FULL WAVE  
RECTIFIER.

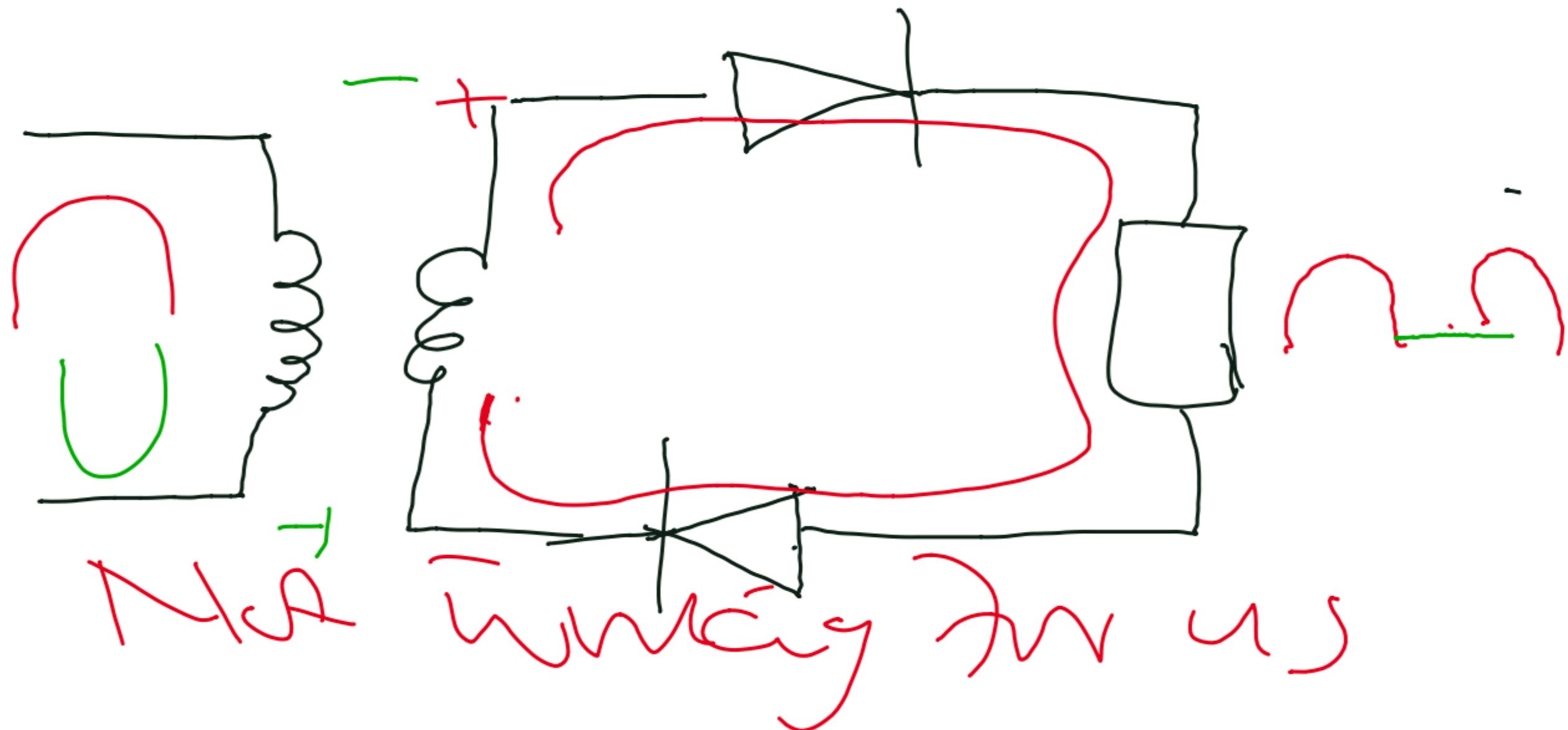
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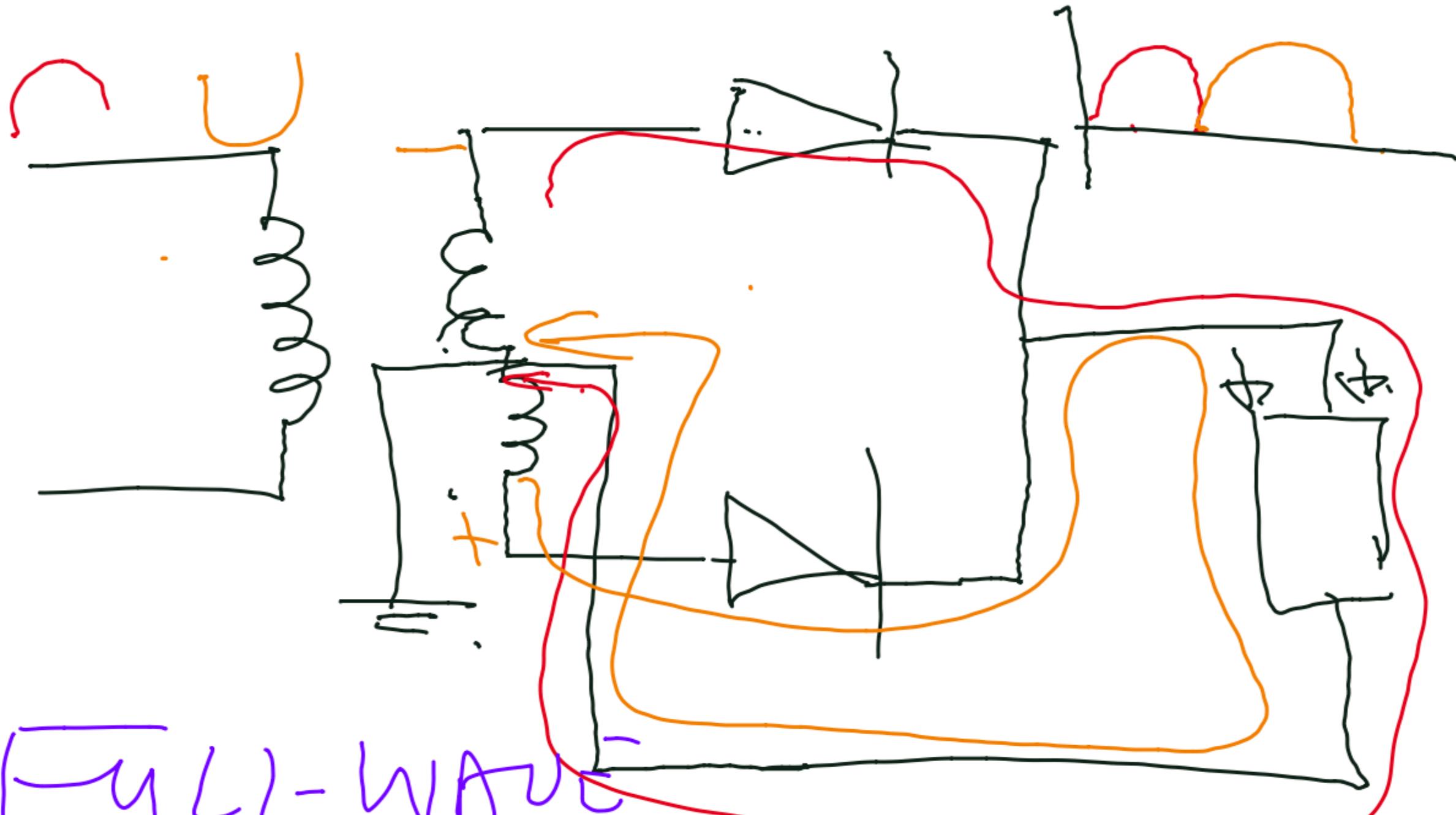




Met

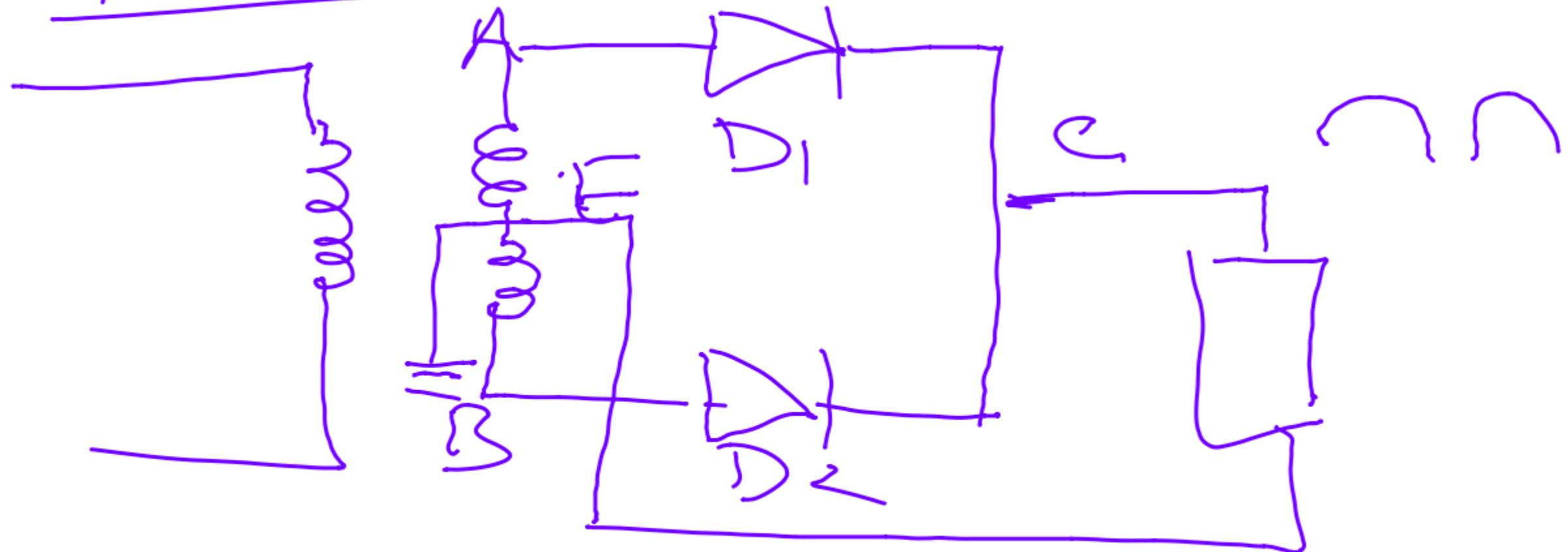
wanting for w.





FULL-WAVE  
Rectifier

Folk-Wave Rectifier  
Using Centre-Tapped  
Transformer



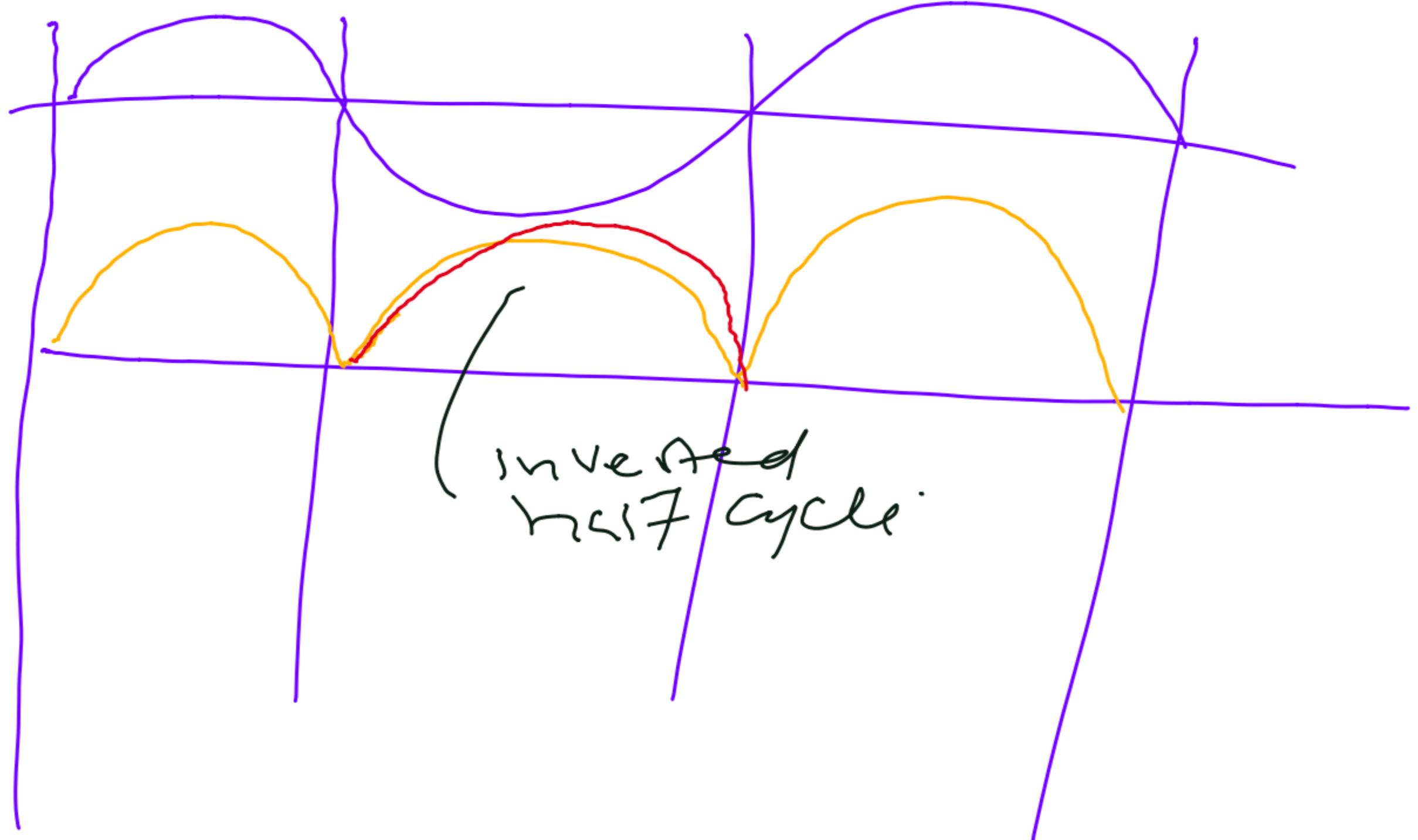
When the Positive half-cycle appears at the Transistors, Point A becomes Positive with respect to Point B.

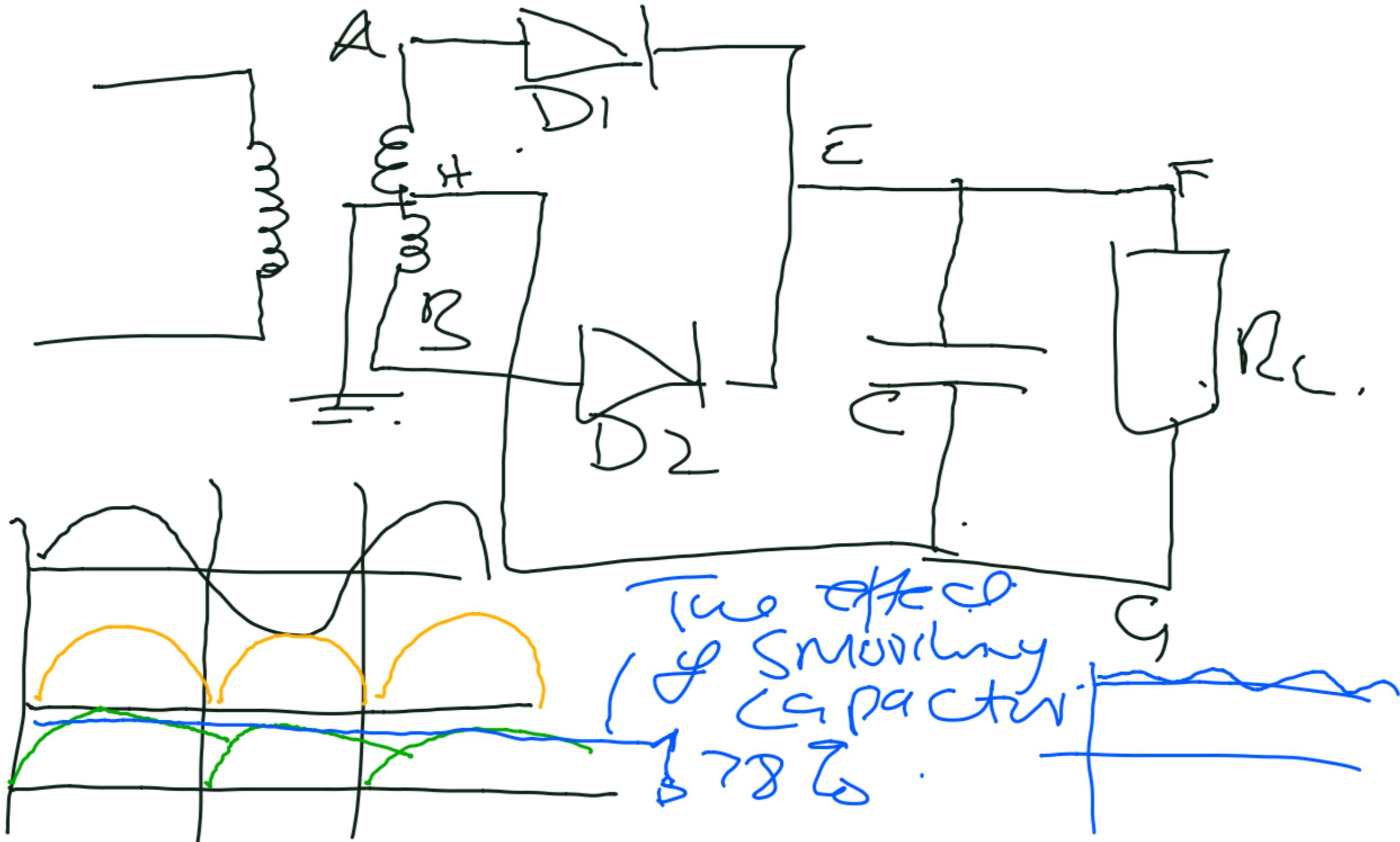
Diodo  $D_1$  is Forward Biased.  
 $D_2$  is Reverse Biased. Current will flow from Point A through  $D_1$  to the load

Back to the Transistor  
Through Point-E Thus  
delivering the Positive  
Half Cycle of the Input -  
to the Load.

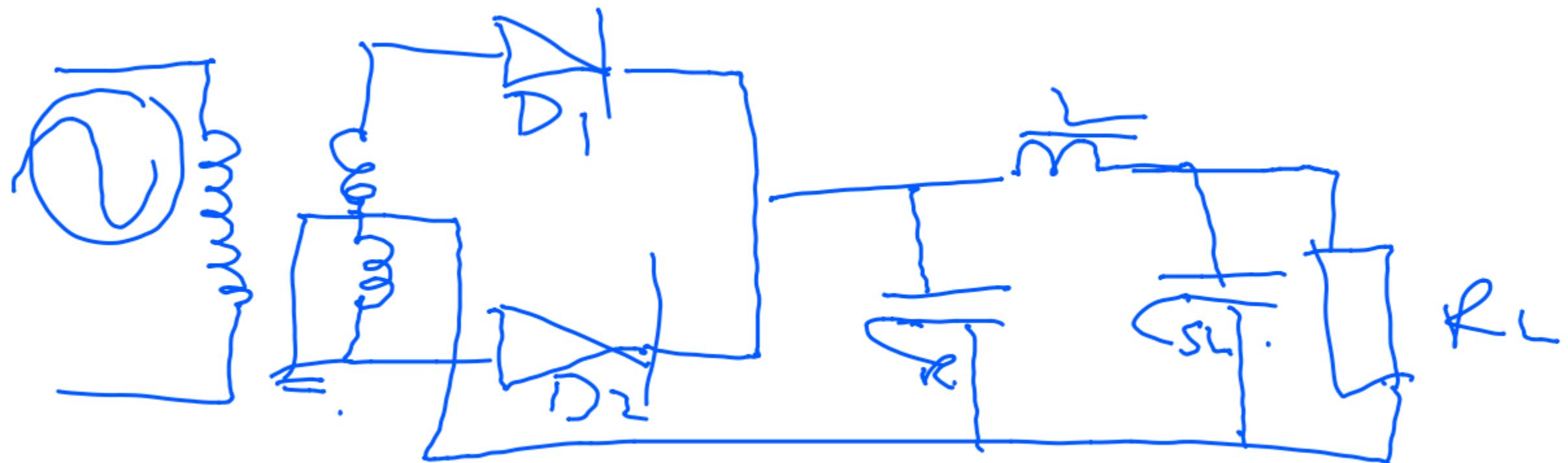
When Point-B is Positive  
will respect to Point-A or  
the Transistor, Diode  
 $D_2$  is Forward Biased and Di-

is Reverse Biased.  
The current will flow  
in the path from  
R to Diode  $D_2$  to point  
through the load resistor  $R_L$   
to point E back to  
the Transformer, thus  
delivering the other half-  
cycle but inverted  
the output.



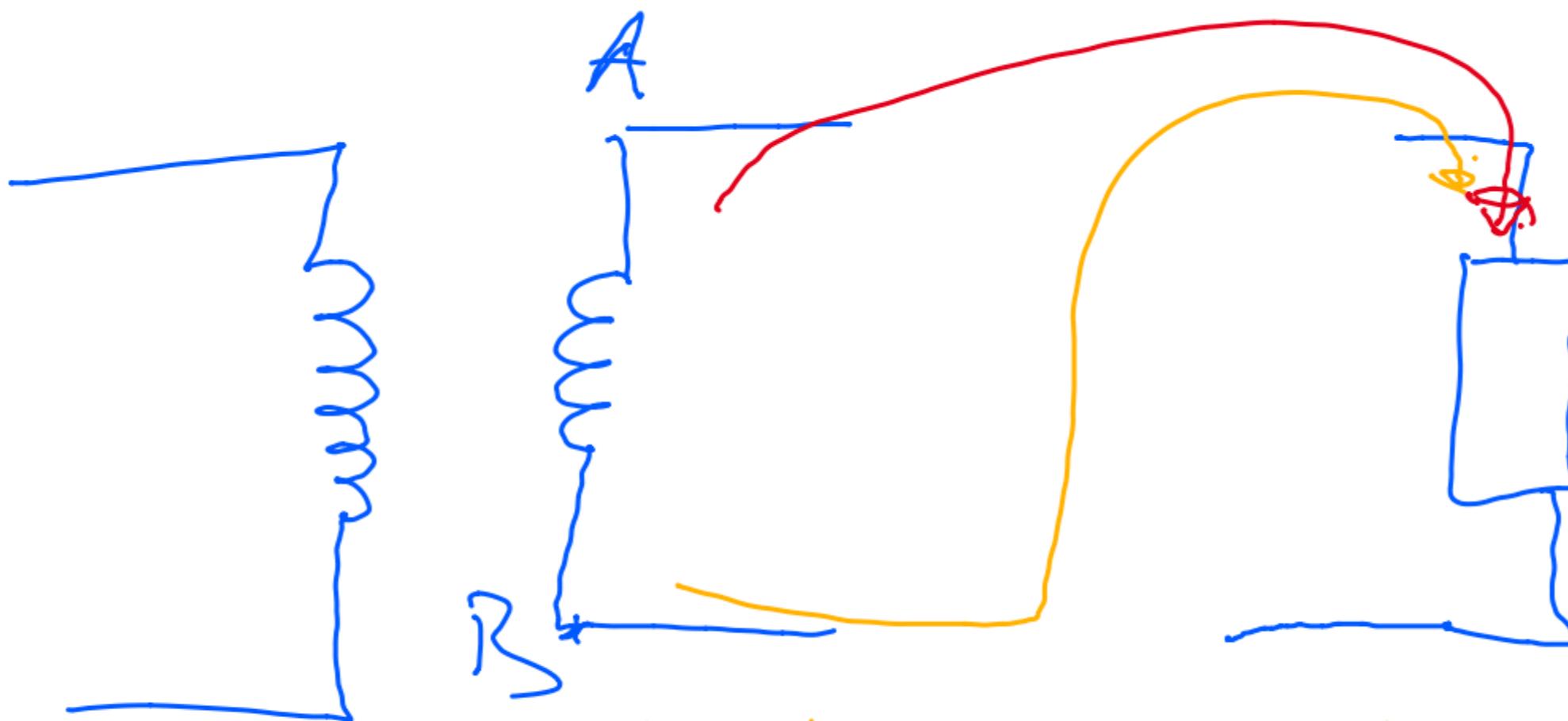


To Remove Line  
Ripples on Line DC  
Signal will have line induced  
line noise. Start Generation  
are introduced.

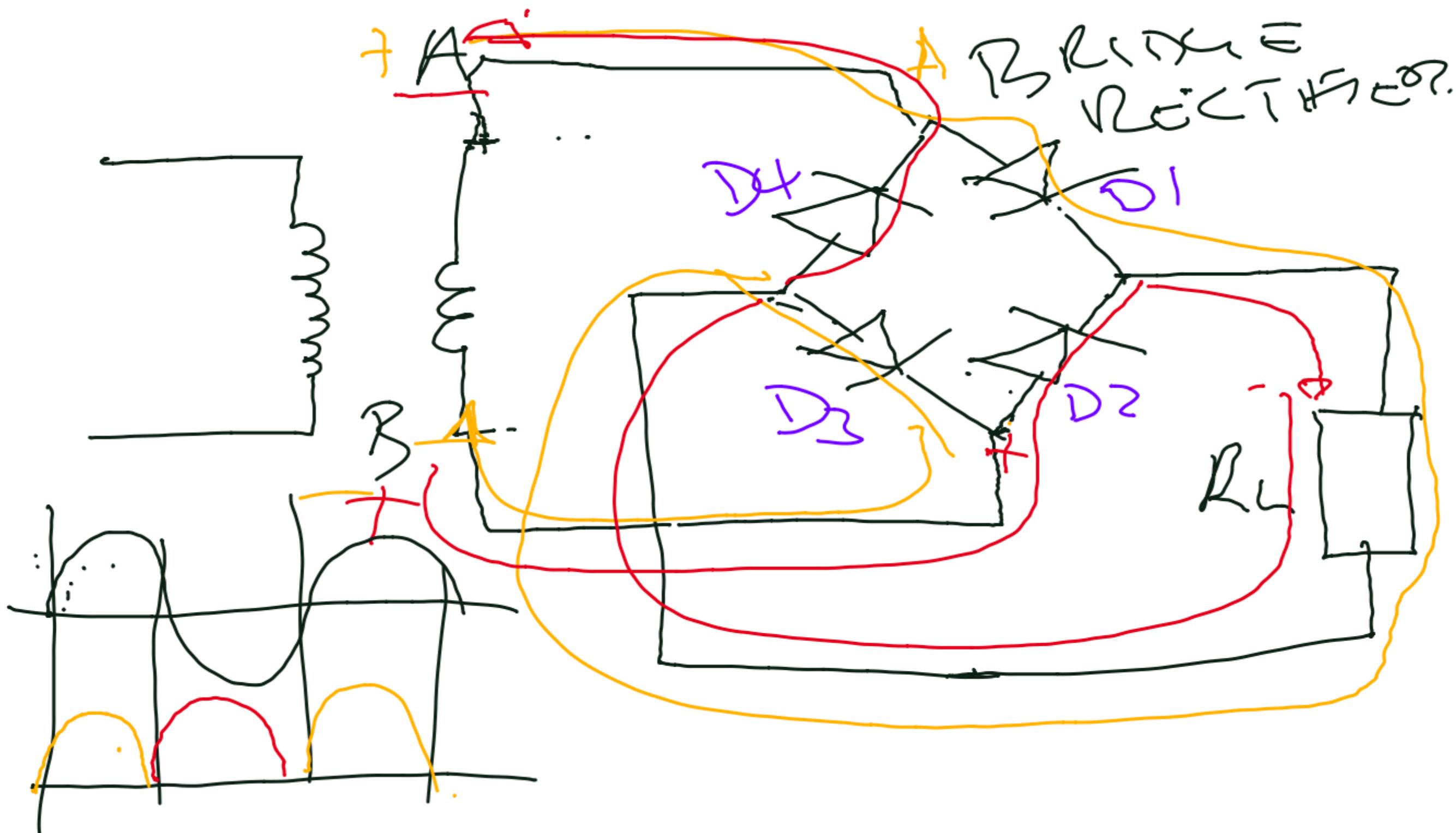


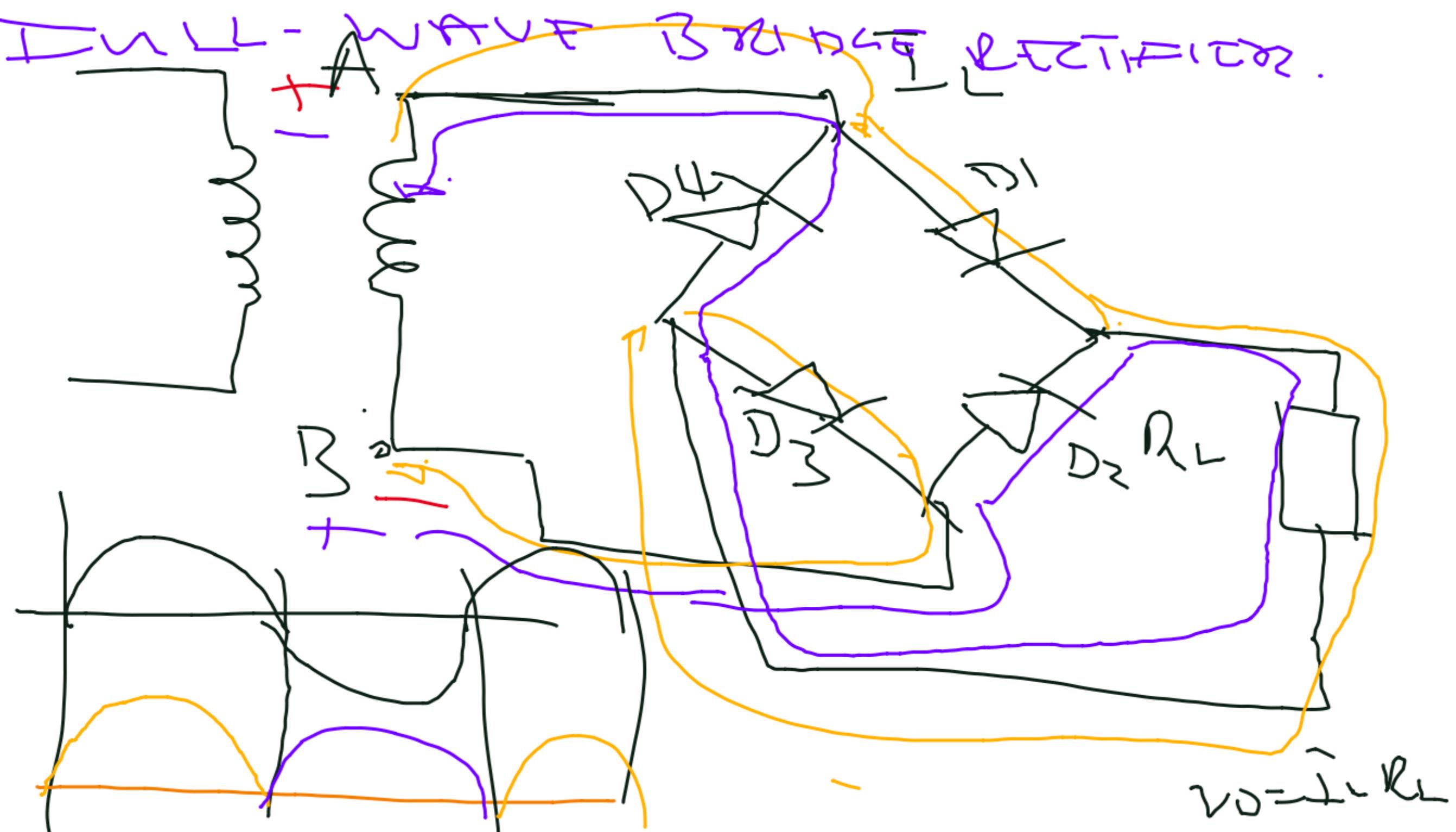


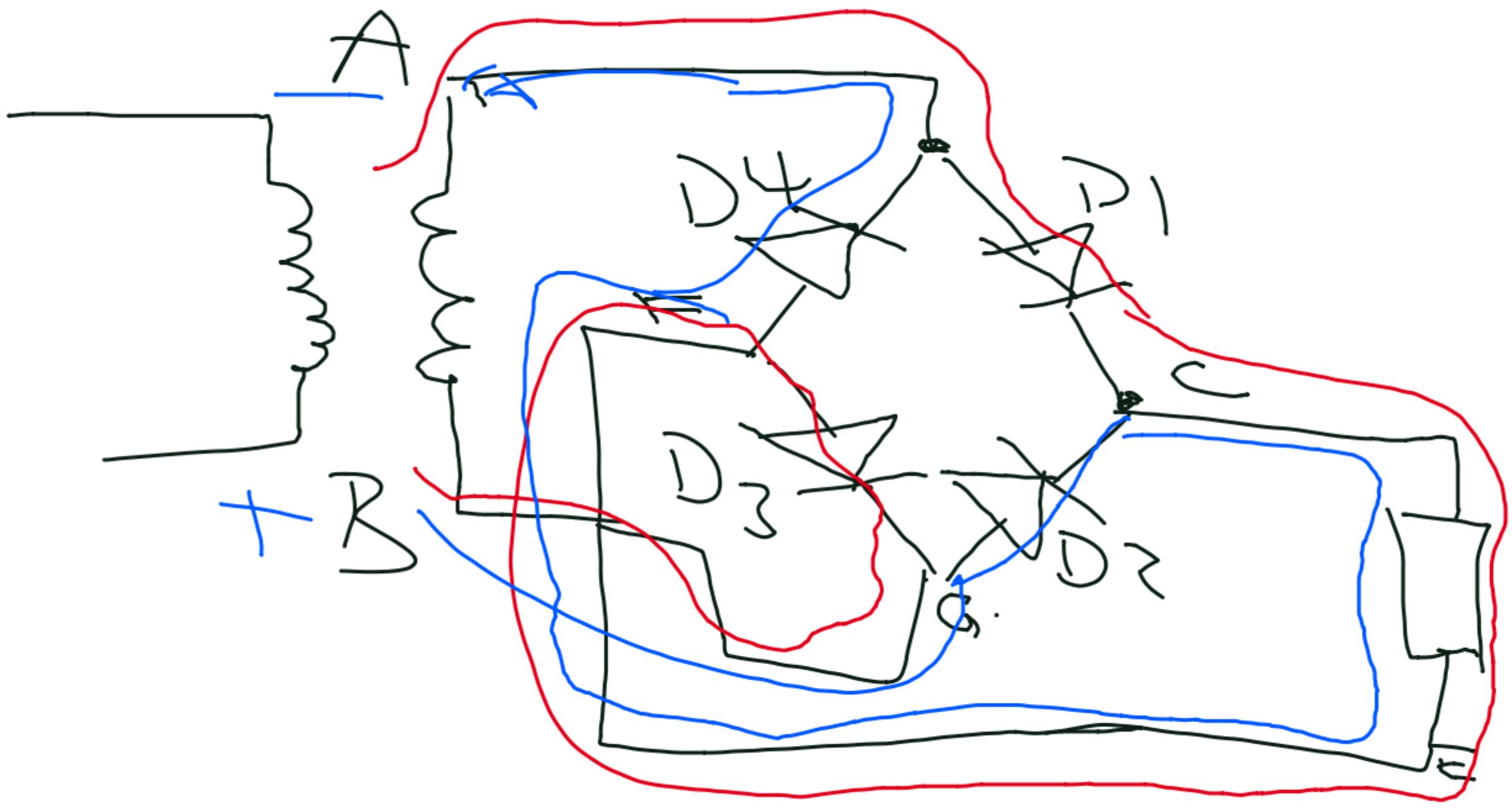
$R_z$  and  $D_z$  are introduced  
to stabilize the output  
thus stabilizer circuit.



Wheat Stone +  
Bridge .







At the instant when  
Point A on the Transistor  
is positive with respect  
to Point B, Diode  $D_1$  is  
forward biased and  $D_4$  is reverse  
biased current will flow  
through  $D_1$  to C at point  
 $D_2$  is reverse biased

The Path from the current  
is through the load resistor  
to E and then to F.

At F Diode D<sub>4</sub> is  
reverse biased and  
D<sub>3</sub> forward biased  
current will flow through  
D<sub>3</sub> to point G. At G, Diode  
D<sub>2</sub> is reverse biased. current

Will flow from G to  
B thus Back to  
the Transformer  
Completing the Positive  
Half Going half cycle

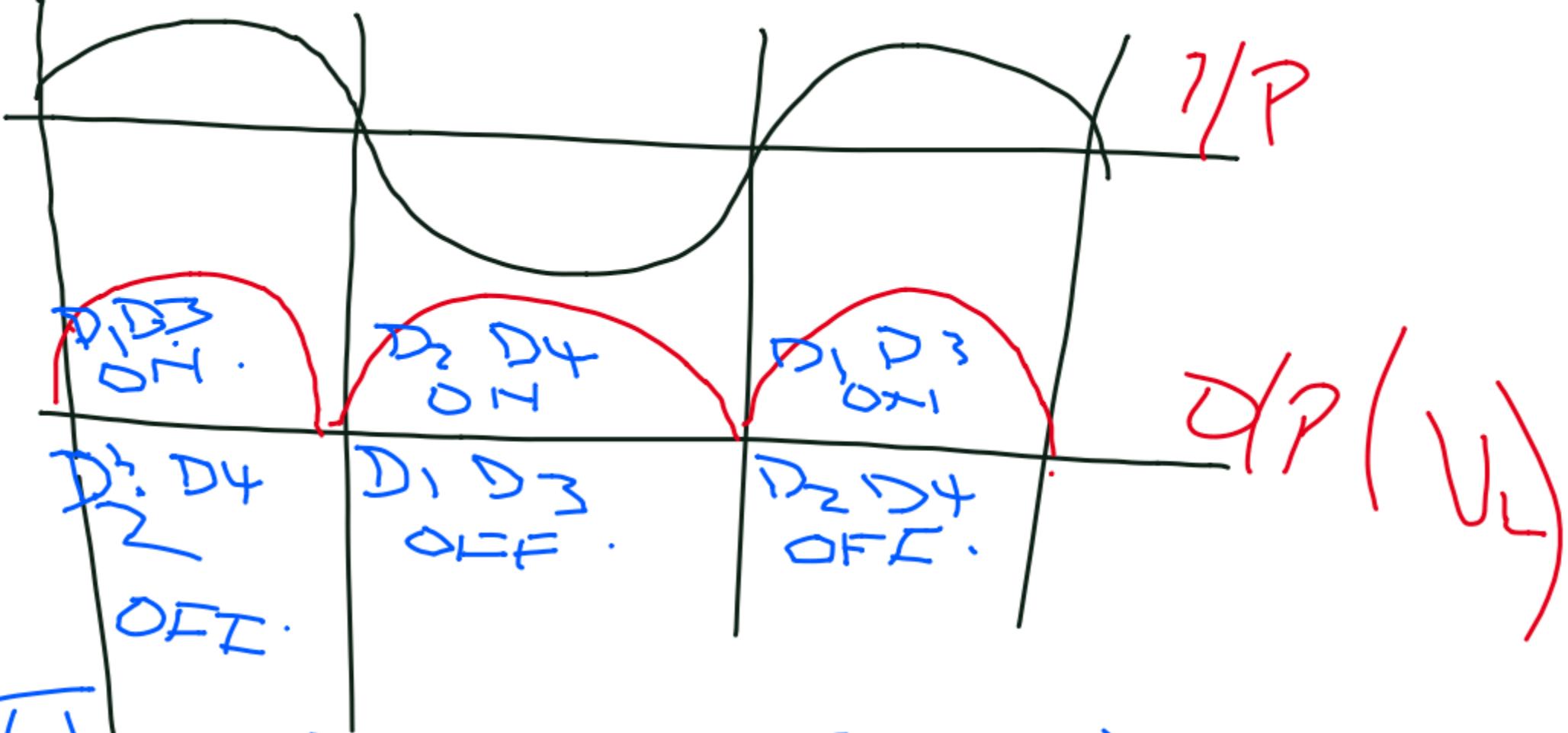
At the instant when Point  
A is Negative with respect to  
Point B, Point G is Positive  
Diode D<sub>3</sub> is Reverse Biased

Diode D<sub>2</sub> is Forward Biased  
Current will flow through D<sub>2</sub>  
to point C. At point C  
Diode D<sub>1</sub> is Reverse Biased  
current will flow from  
C to the load through E + F.  
At F Diode D<sub>3</sub> is Reverse Biased While  
D<sub>4</sub> is Forward Biased Current:  
flows the path of D<sub>4</sub> to point A  
At A the Diode D<sub>1</sub> is Reversed  
Biased the current returns to the

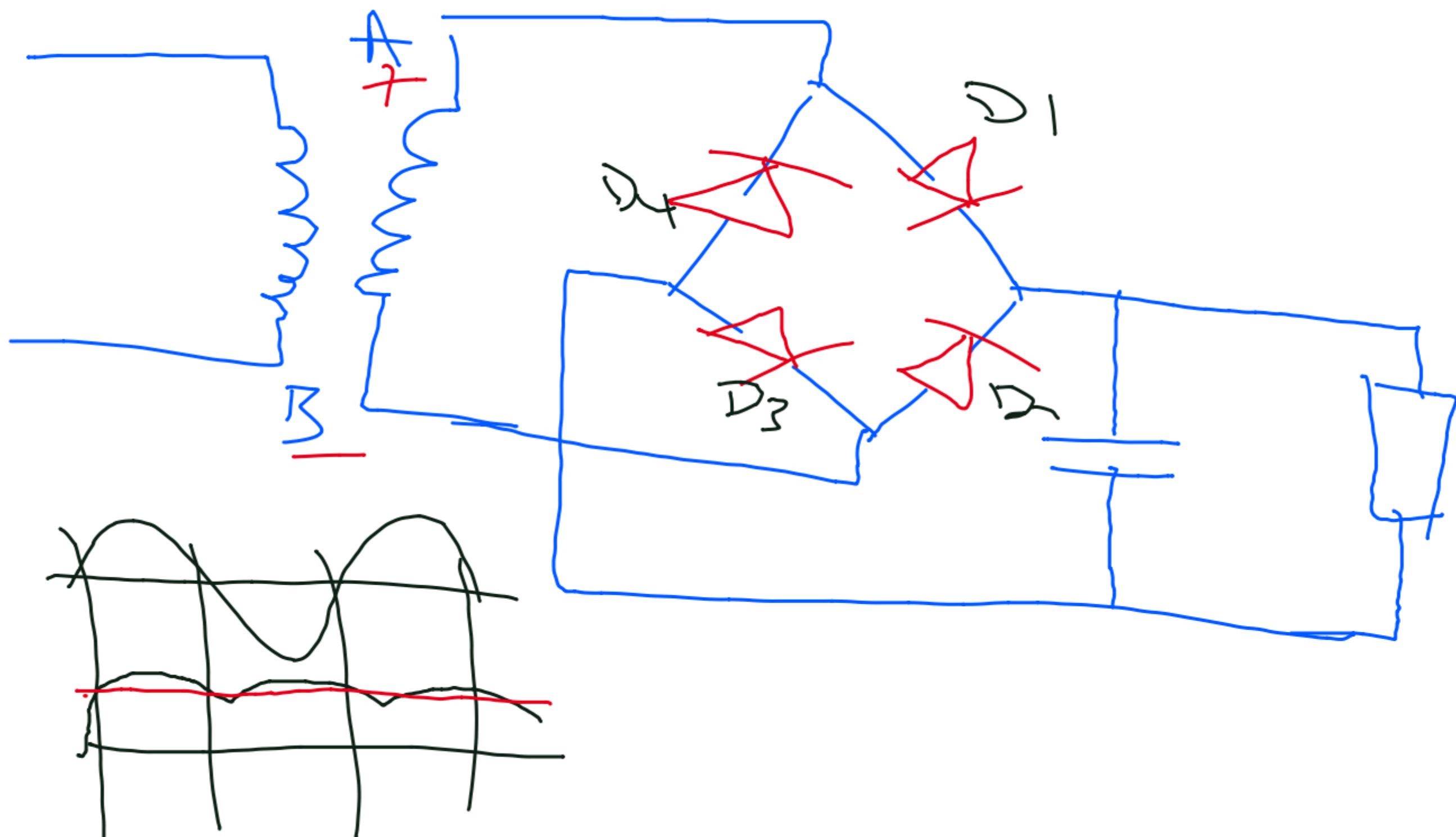
The Transformer Line  
Completing its Negative  
going half cycle.

This results in Both the  
positive and the negative  
going half cycles at the  
impulse providing positive  
ns17 cycle at the output.

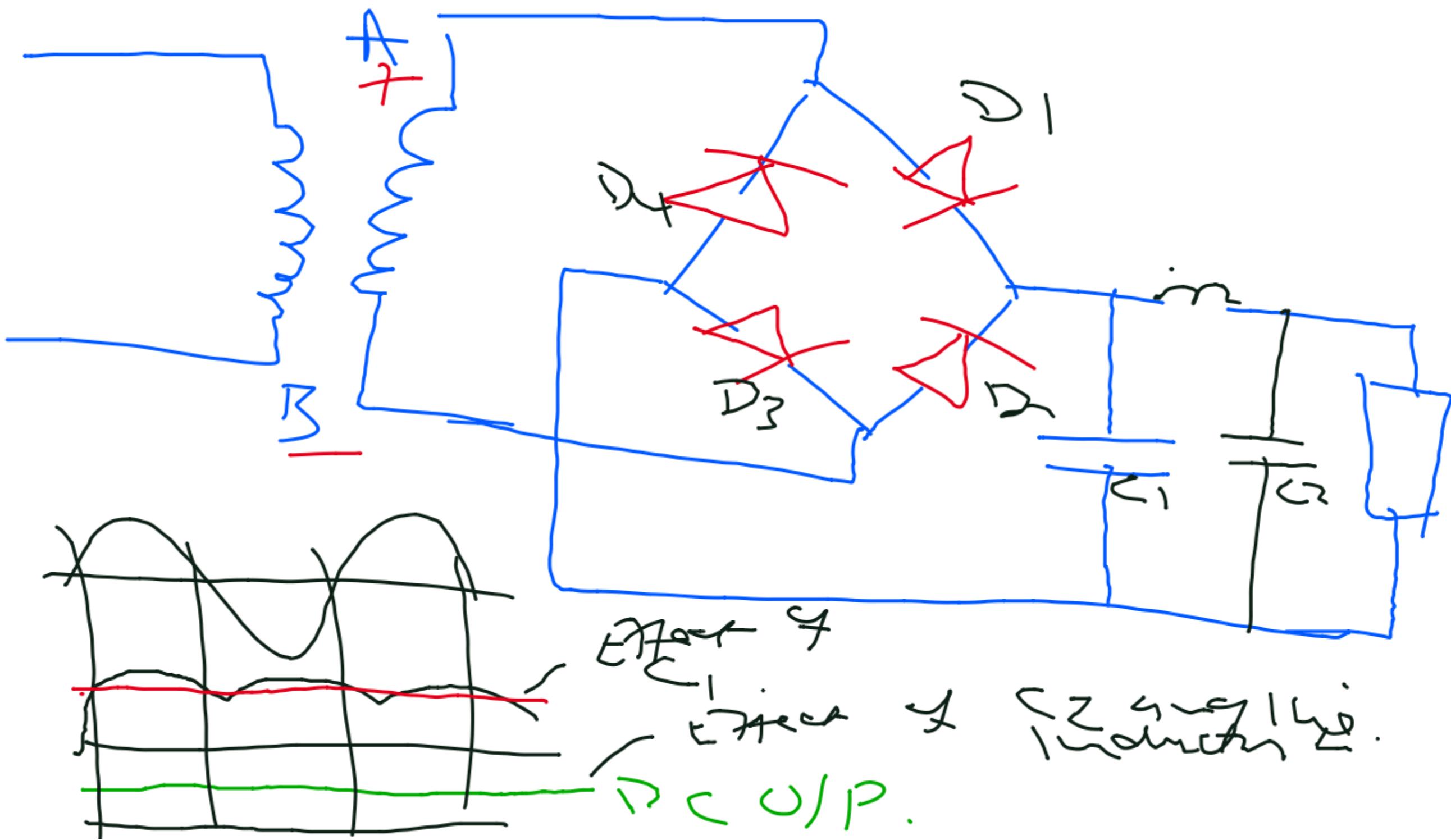
The Output Signal is  
Unidirectional i.e. D.C.



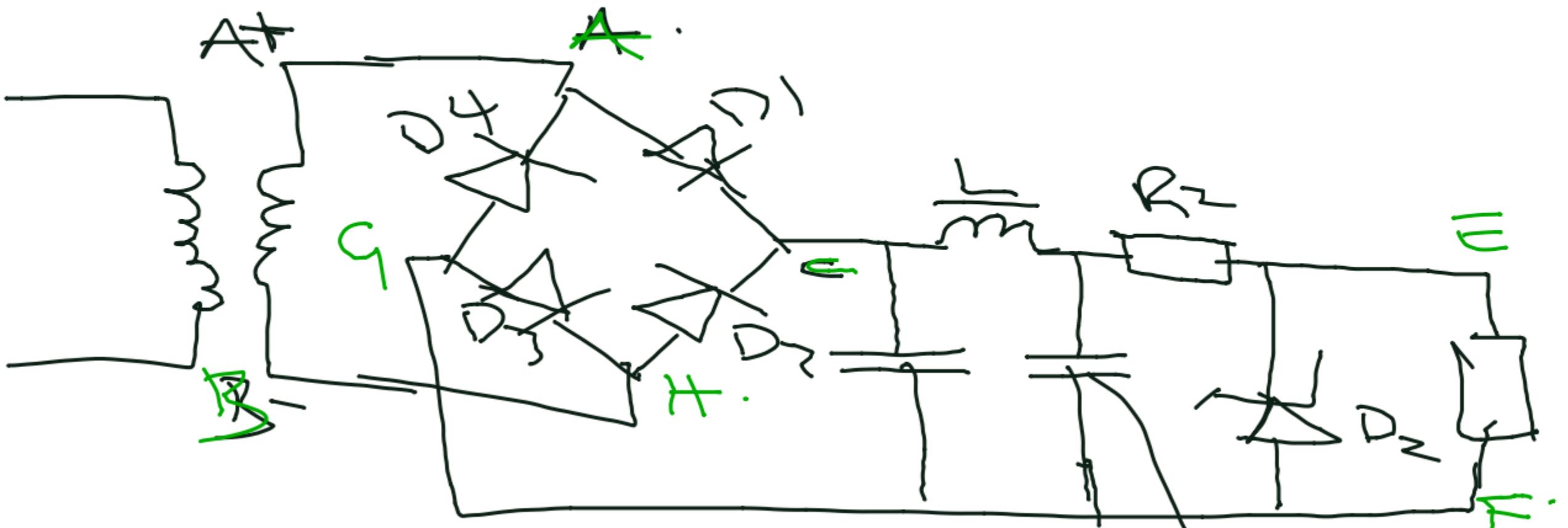
The Out-pu<sup>t</sup> is in form of  
Unidirectional Pulses Which Need  
to be Shaping D.C.



The introduction of  
the Gyrator C1  
Smoothens the  
output - Pulse to power.  
D.C. signal. The  
ripples will be removed  
by introducing a filter circuit  
of the inductor with shunt  
capacitor.



Will give introduction of  
Inductor as the current  
resistor ( $R$ ) between the wood  
and the ground will give  
the reading at the top of the stick  
when it is submitted to ground  
leaving the probe close to  
tiger to the wood.  
This will give results in  
a filter circuit.



Bridge Rectifier Base Shunt Capacitor  
 Full-Wave Stabilized  
 Power Supply Unit,

The Incusin - > the  
Zener diode and  
the Zener Resistor in  
the circuit stabilizes it in  
say -> Rated at 10V the  
out - put - will remain constant  
at 10V even if the input  
voltage increases to a higher  
value. The output is  
Regulated.

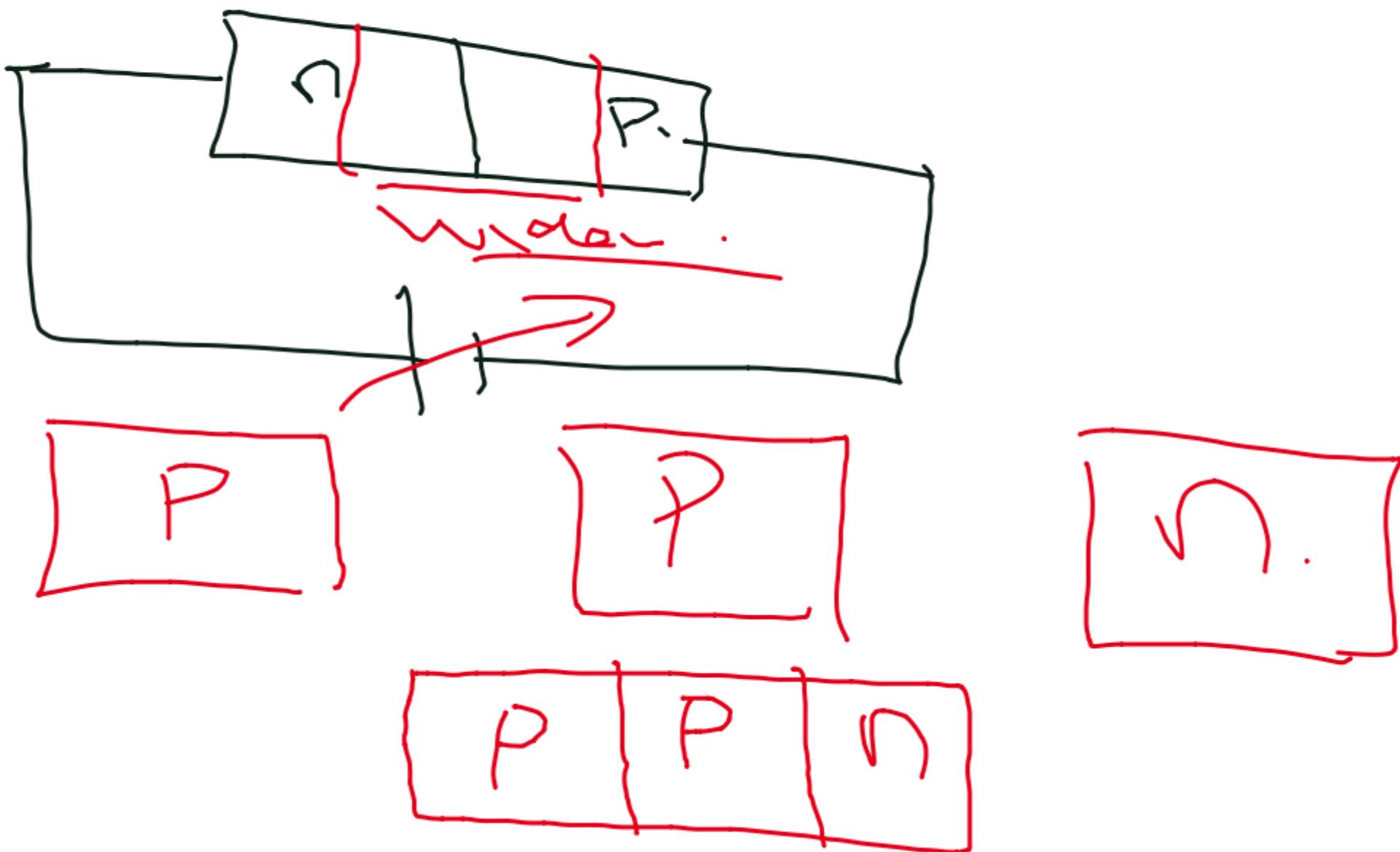
# Assignment-

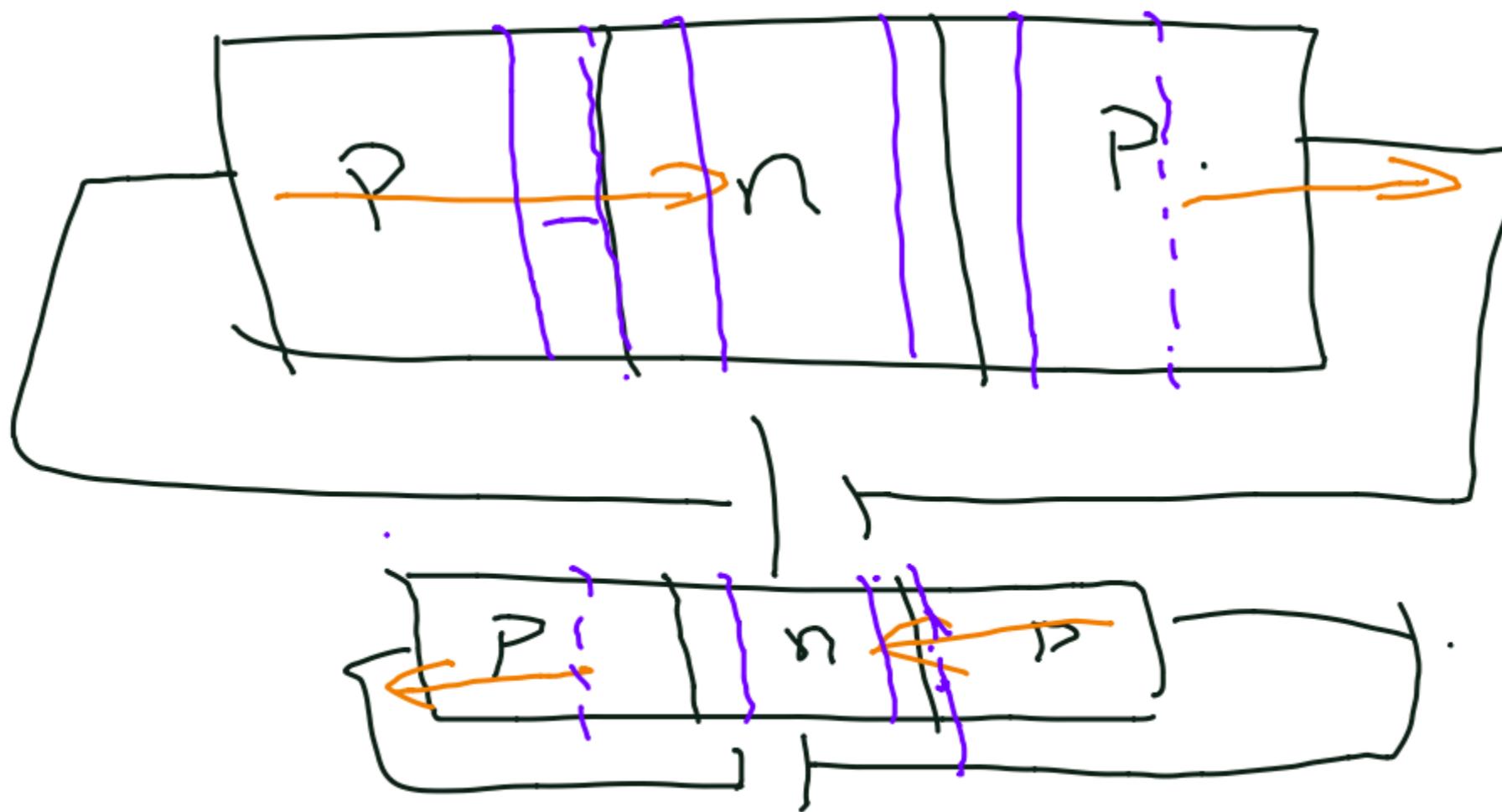
Read and Write  
Notes on 1  
Zener diode.

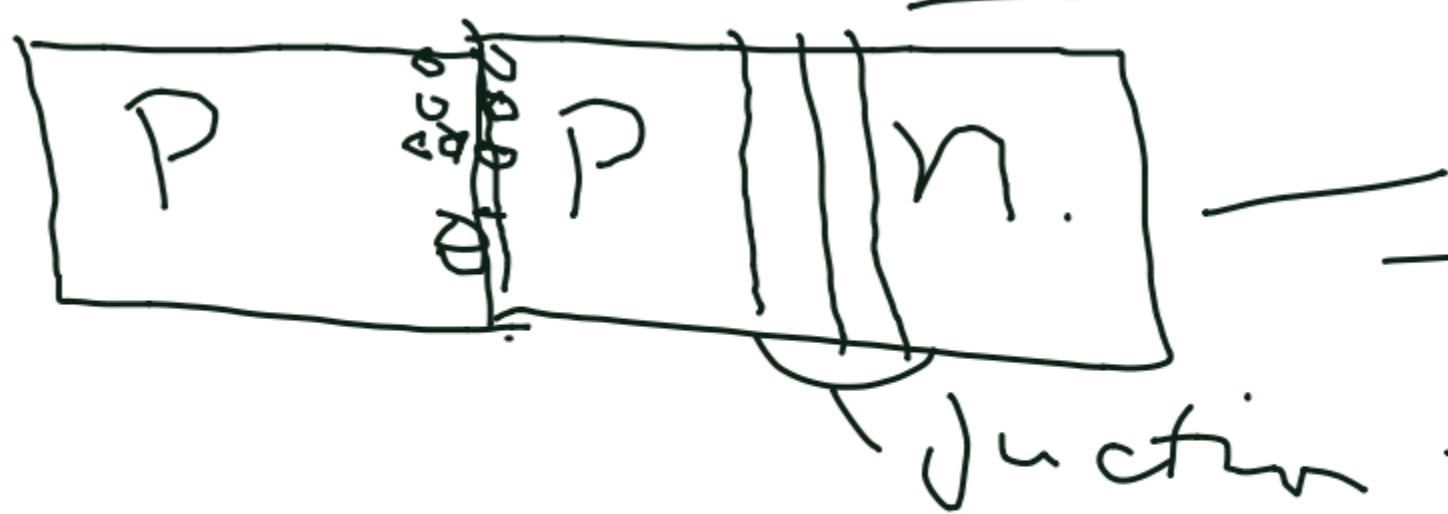
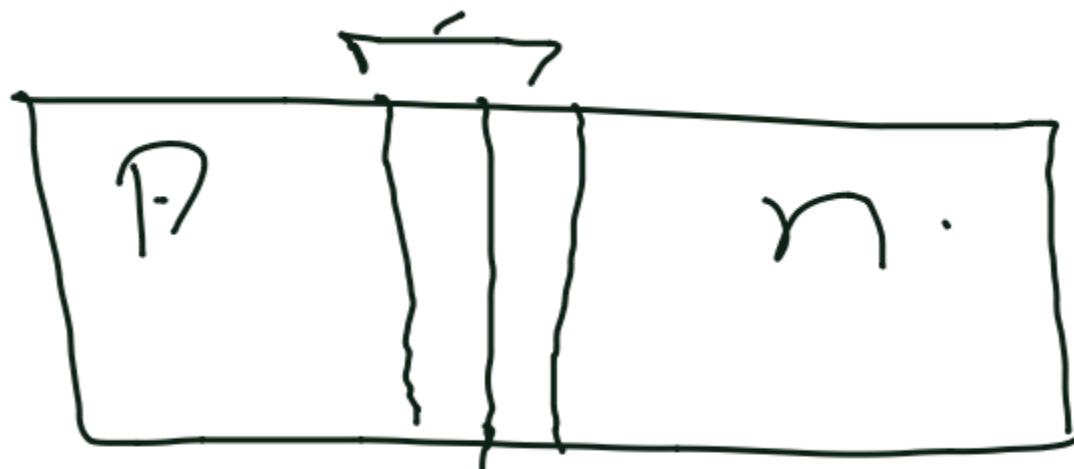
- (1) Formation.
- (2) Operation.

(c.t.d). Photo diode

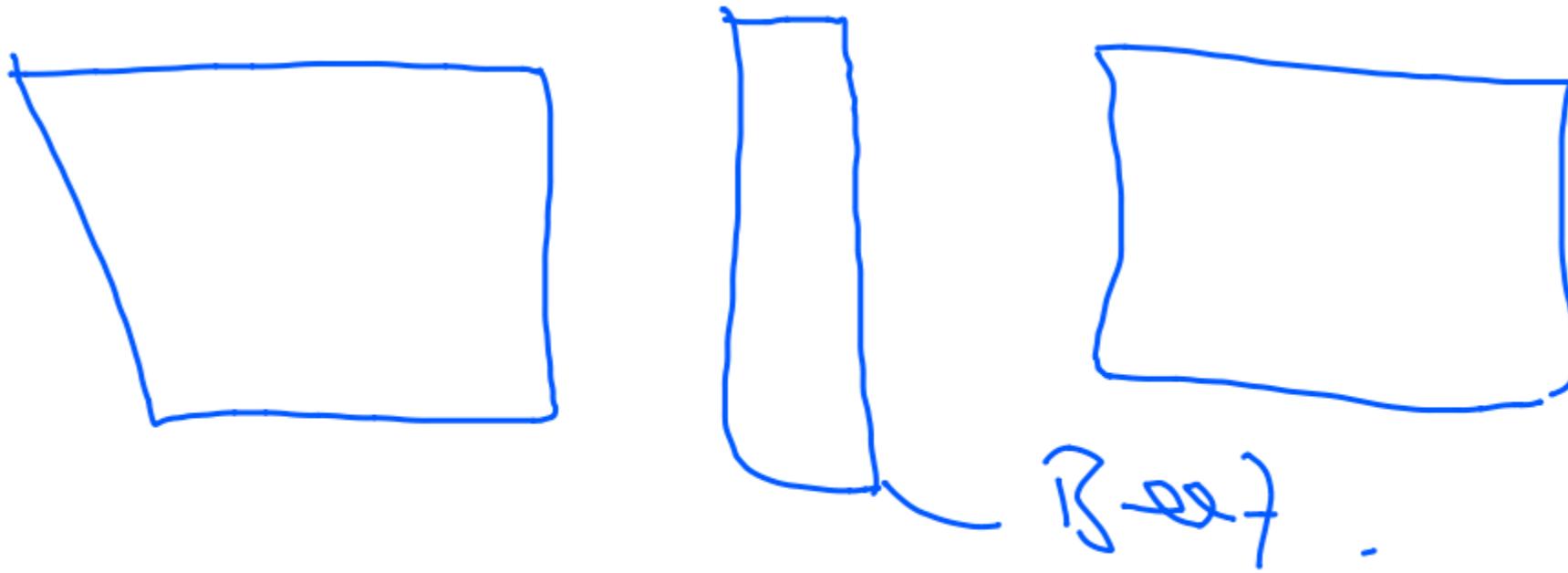
# TRANSISTOR RESISTOR

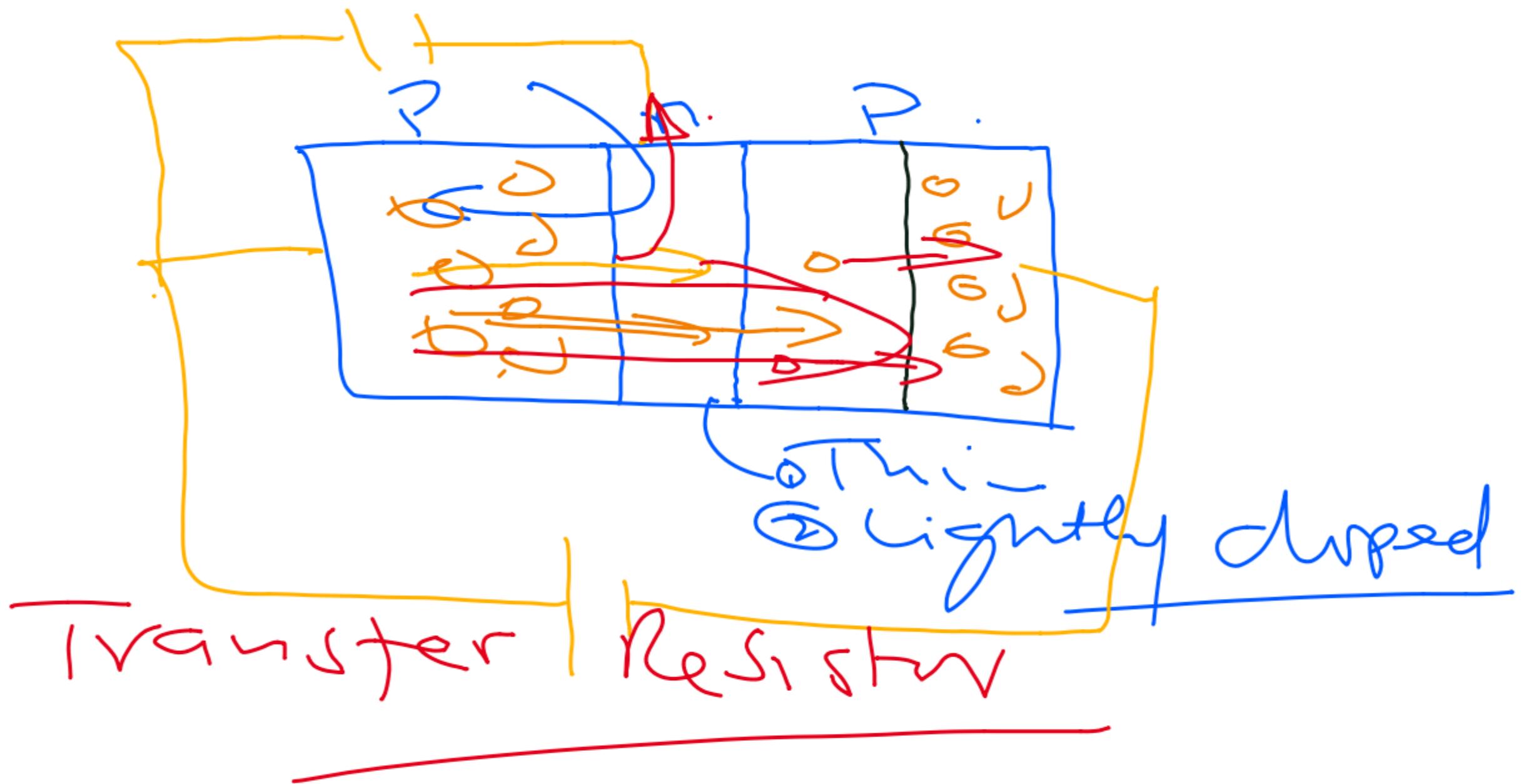


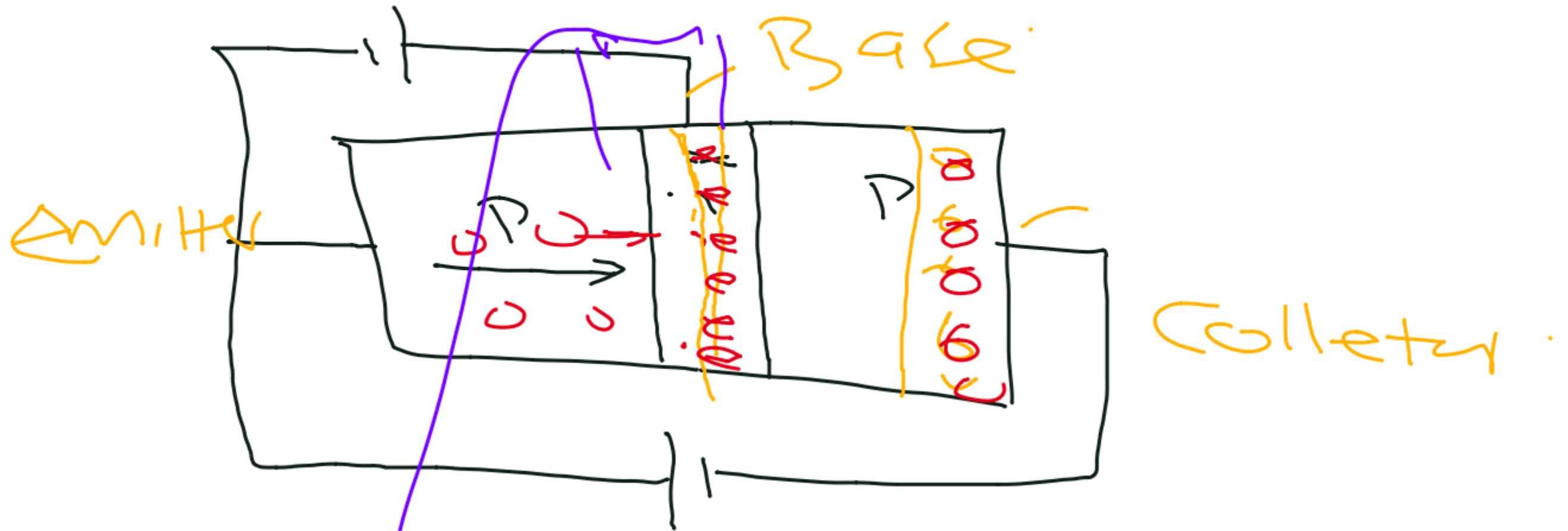




P-n Junction







Pn Junction is Reverse Biased.  
 The depletion region widened  
 due to charge carriers moving  
 away from the device blocking flow

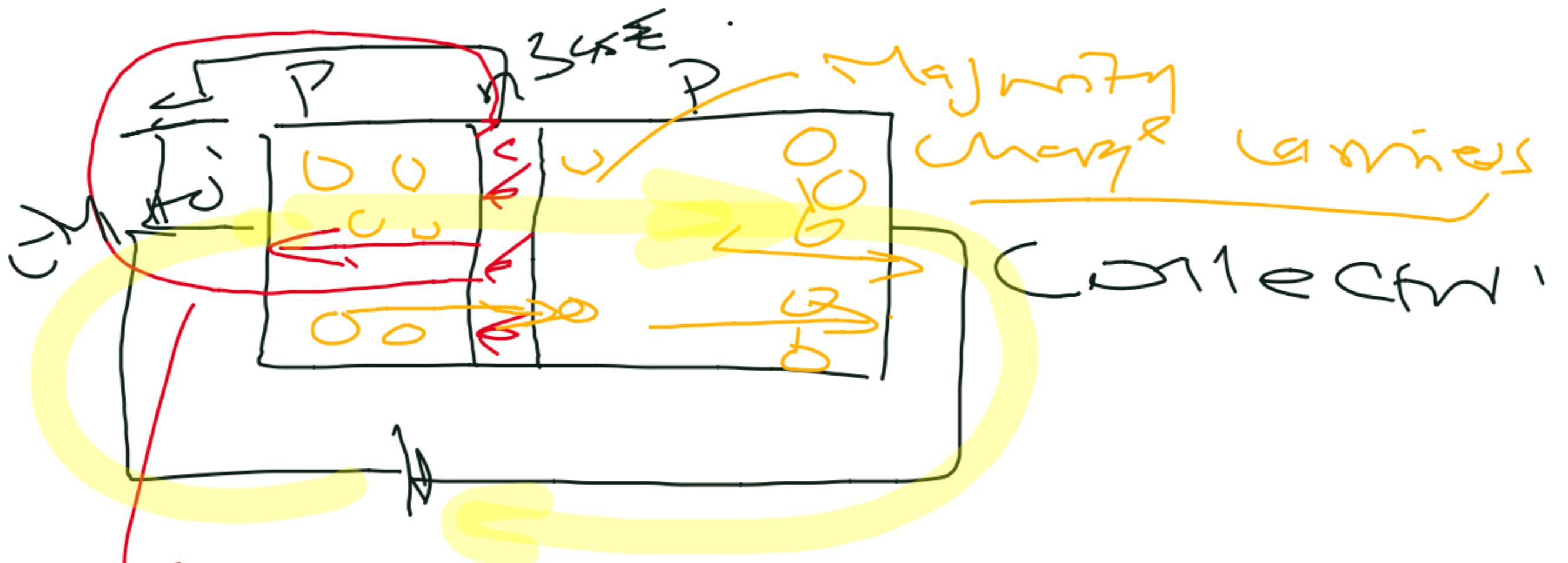
of Charge Carriers  
Never the Current-  
Flow.

The Device Will Allow Current-  
To Flow Through It When  
Base Emitter Junction Is  
Forward Biased And The  
Base Collector Junction Is Reverse  
Biased.

With the Base-emitter  
junction Reverse Biased  
the device will block the  
current flow.

The circuit has two  
types of charge carriers  
that participate in  
current conduction

In the case of the  
PnP devices the  
holes are retained to the  
Majority charge carriers  
whereas the electrons and  
the Minority charge  
carriers.

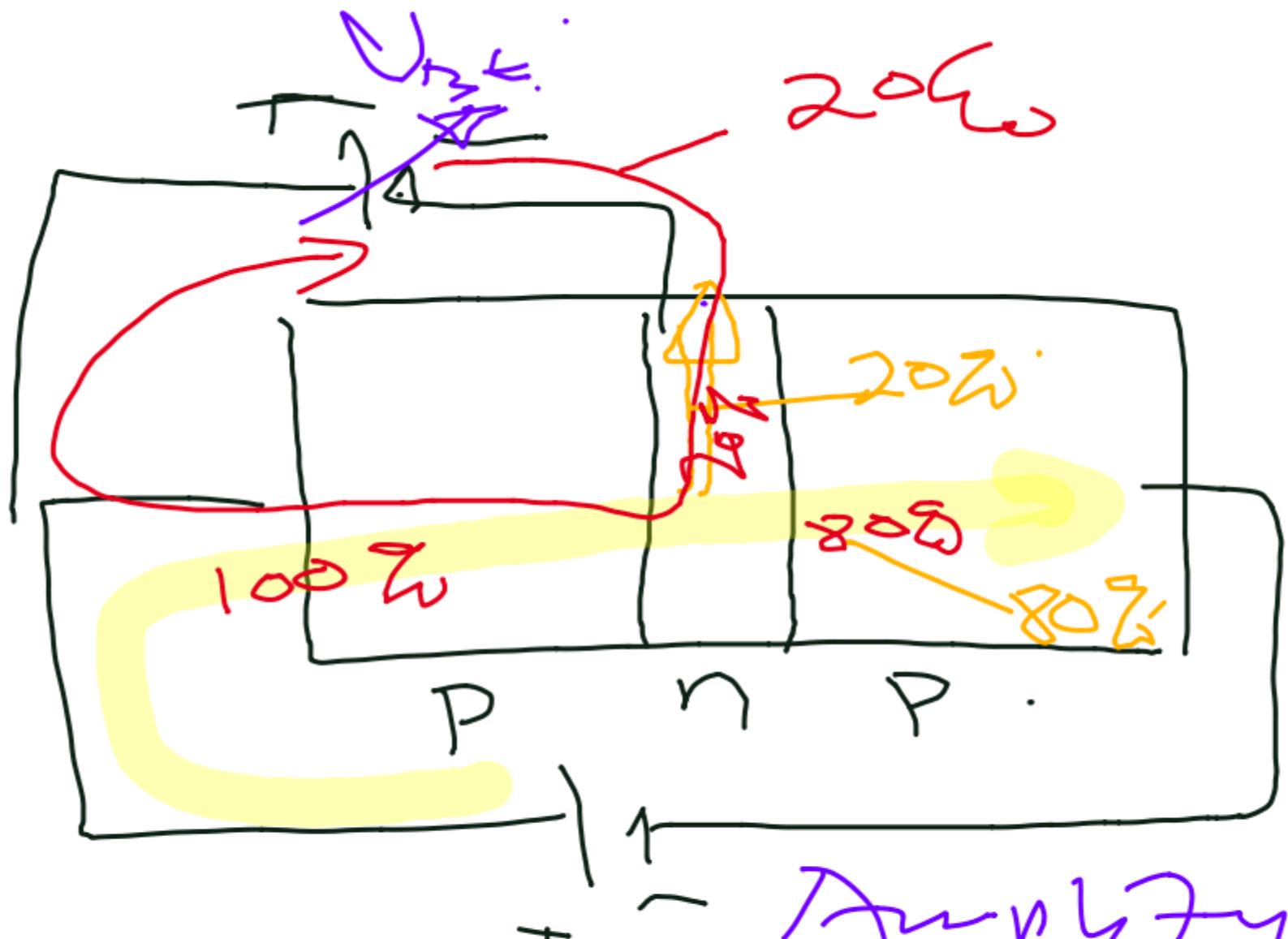


Minority Charge Transfer  
TRANSFER RESISTOR

TRANSISTOR

Transistor is a three terminal device which when appropriately biased will allow current to flow through it. The terminals are known as:

- 1) Emitter (2) Collector
- 3) Base.



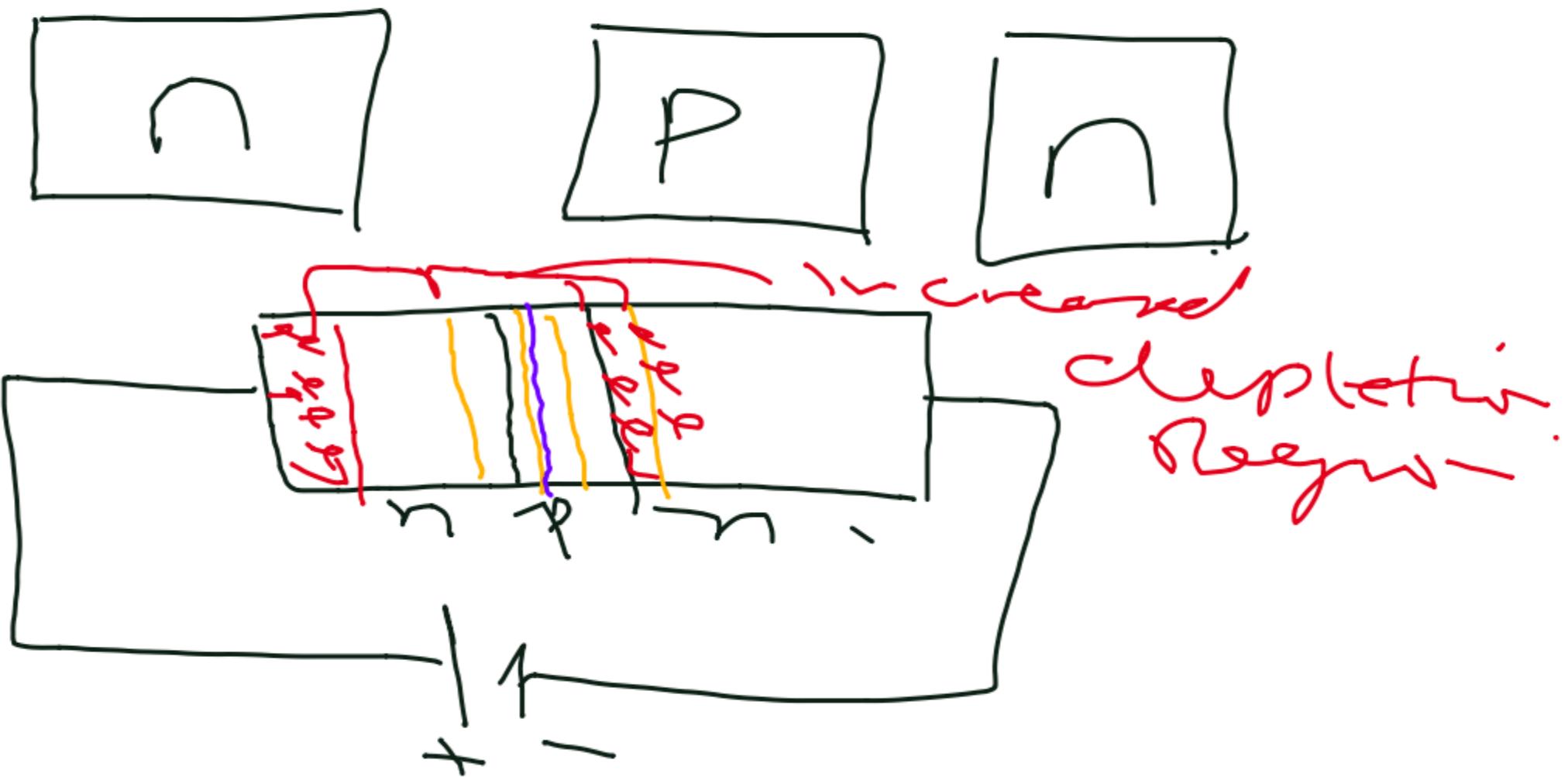
Amplify the signal  
Signet at the B/E  
junction

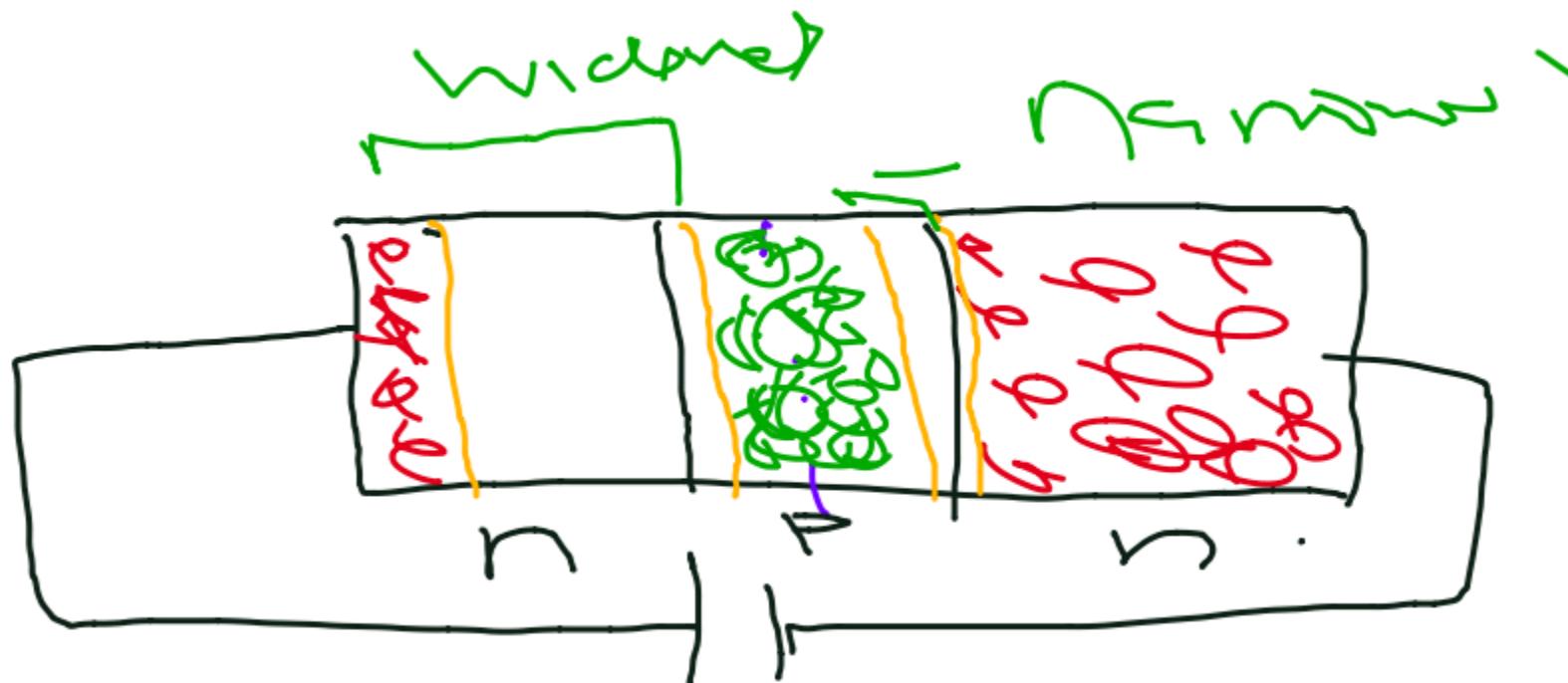
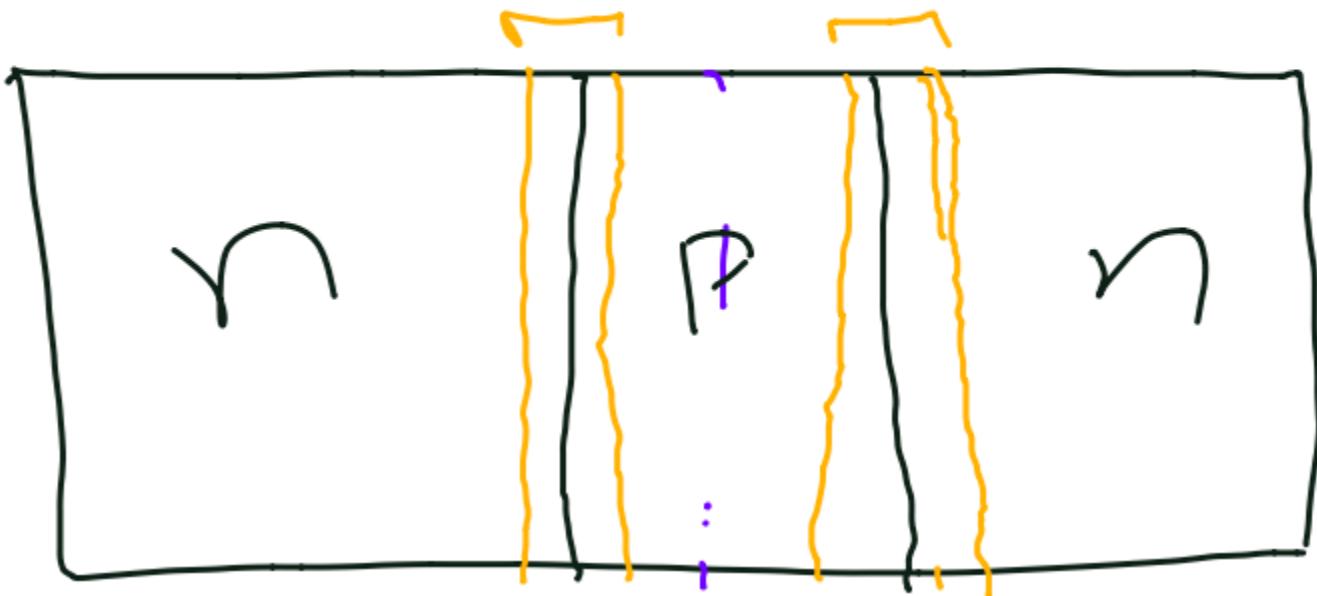


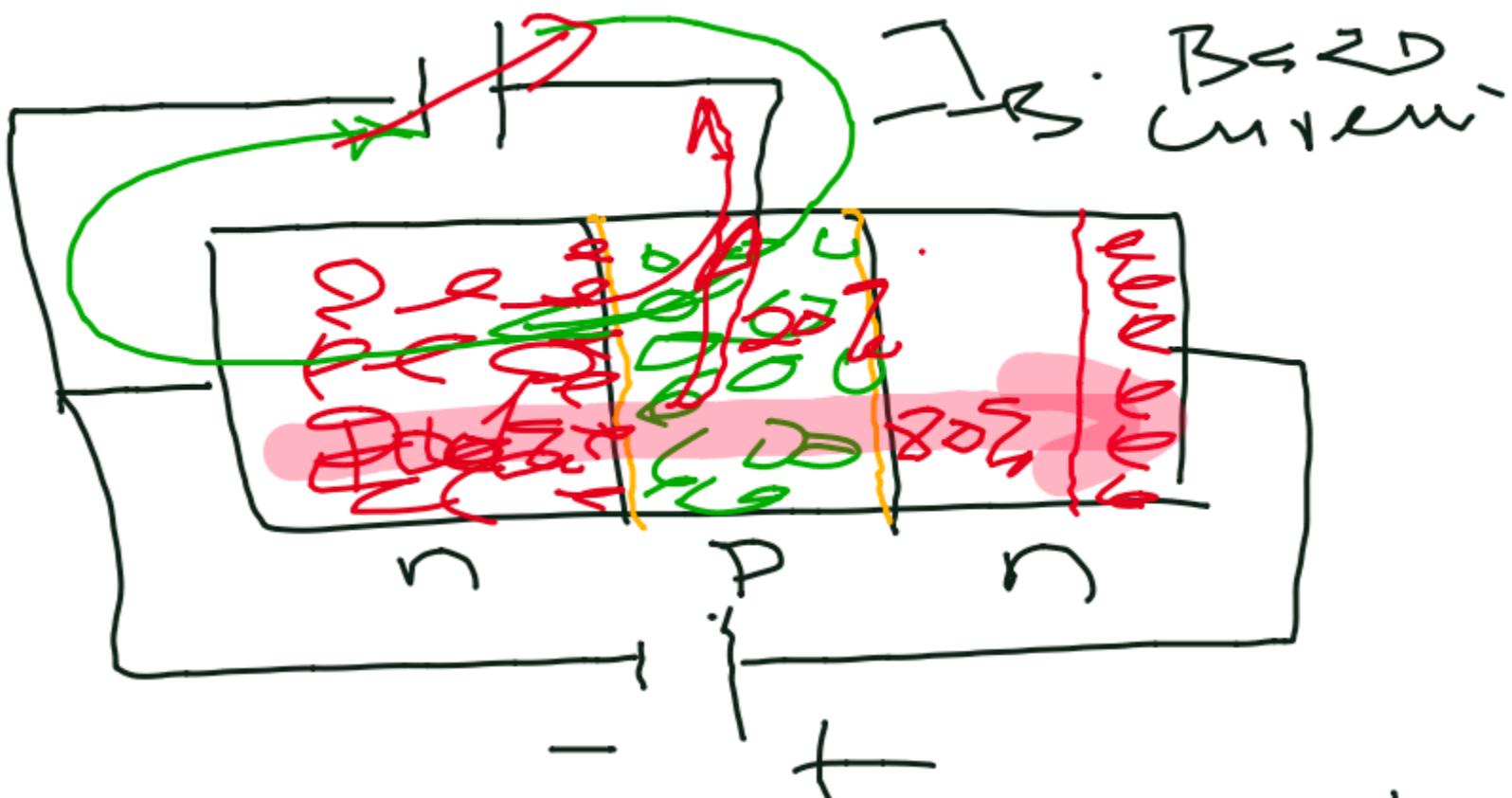
PnP - Transistor.



# NPN Transistor







When the Base-Emitter Junction of the NPN transistor is forward biased and the Base collector pair is Reverse Biased  
The Majority Charge carriers

at - the Base will  
Recombine with some  
of its Majority Charge

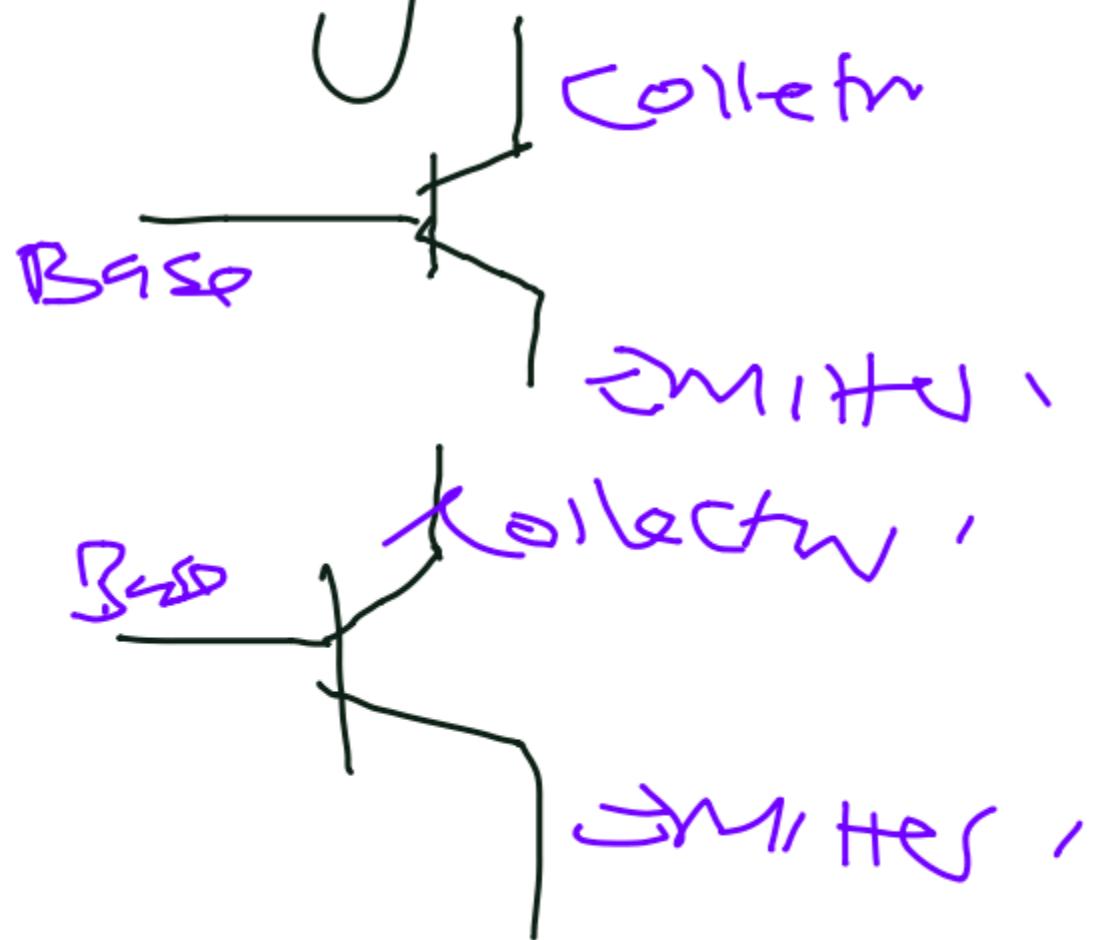
Some from the Smith  
Fr Doctor ) to constitute

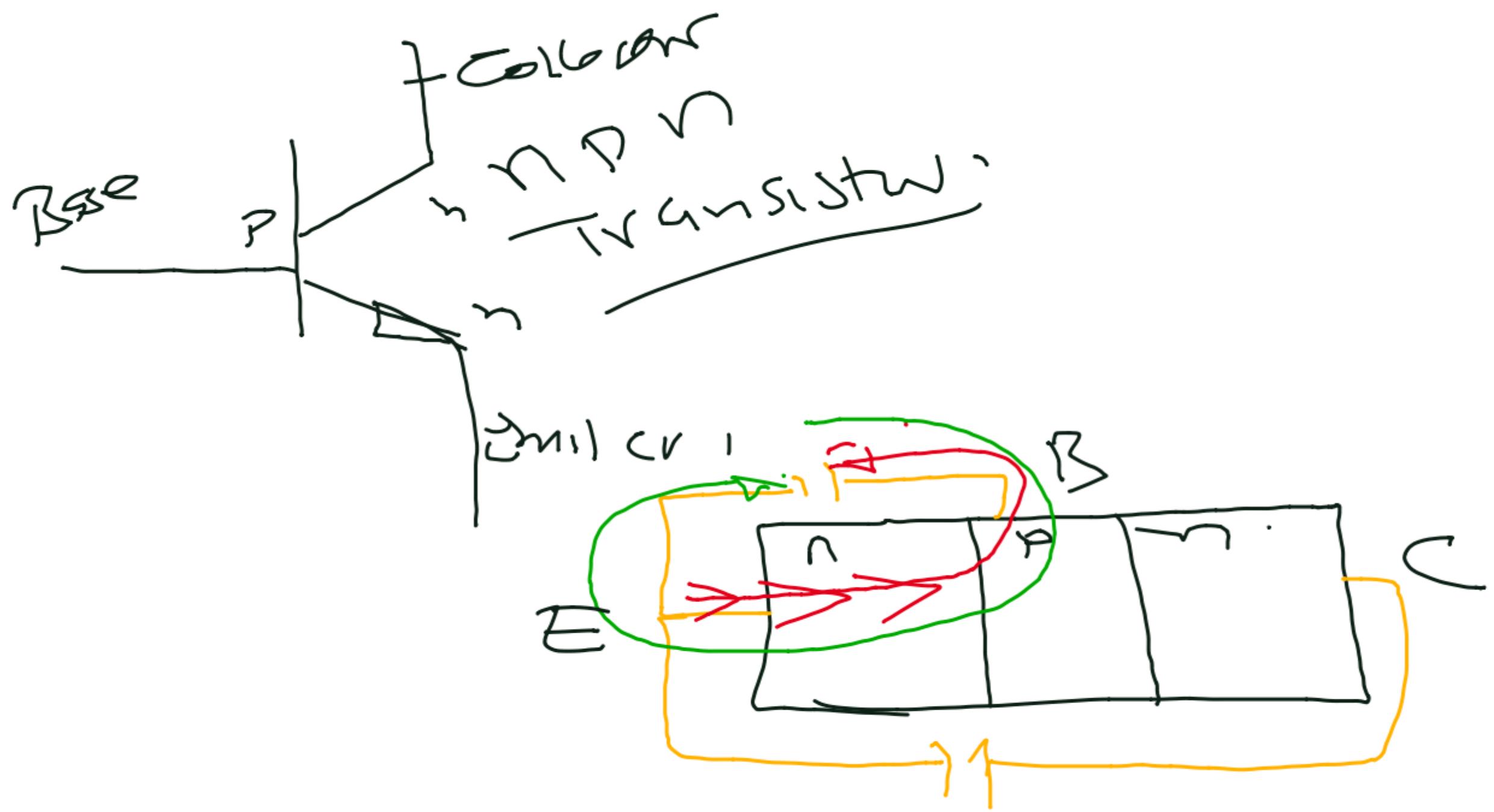
the Base current.  
Most of the Majority Charge  
carriers will penetrate -  
the Base to reach the  
Collector region. This then

Consists w/ Collector  
Emiter Current -  $I_V$   
the device

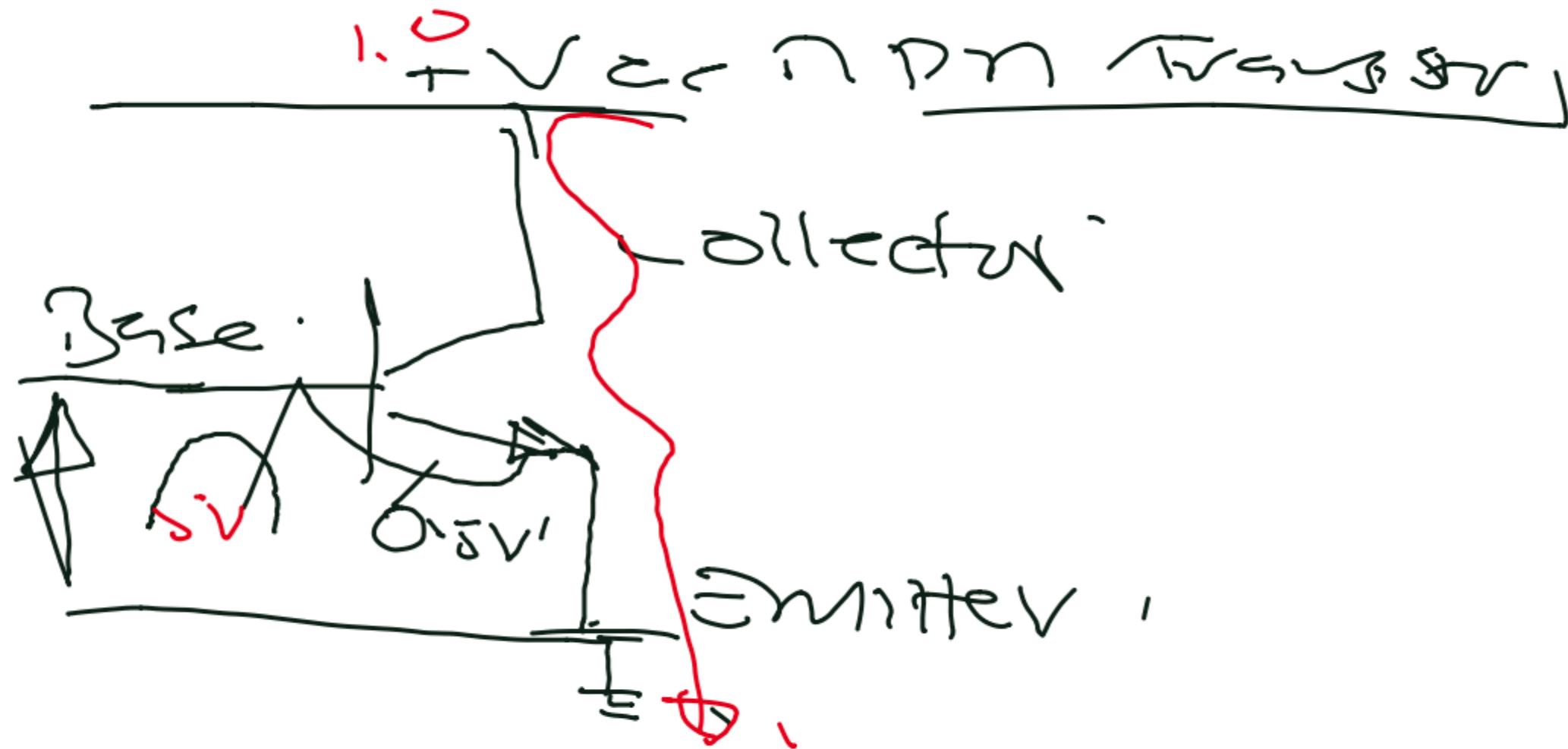
The Proportion of the  
Current division is such that  
the Base current is 22 times as  
the Collector Current - is  
98%

# Transistor Electron. & Circuit Symbols.





# Transistor as a Diode

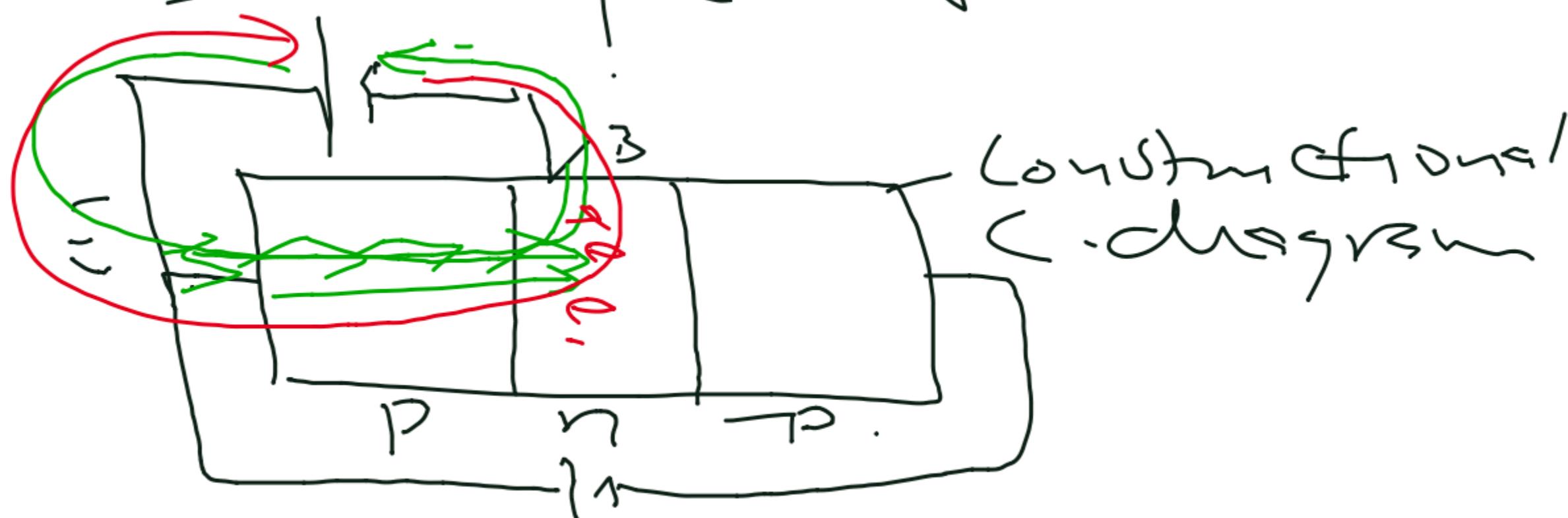


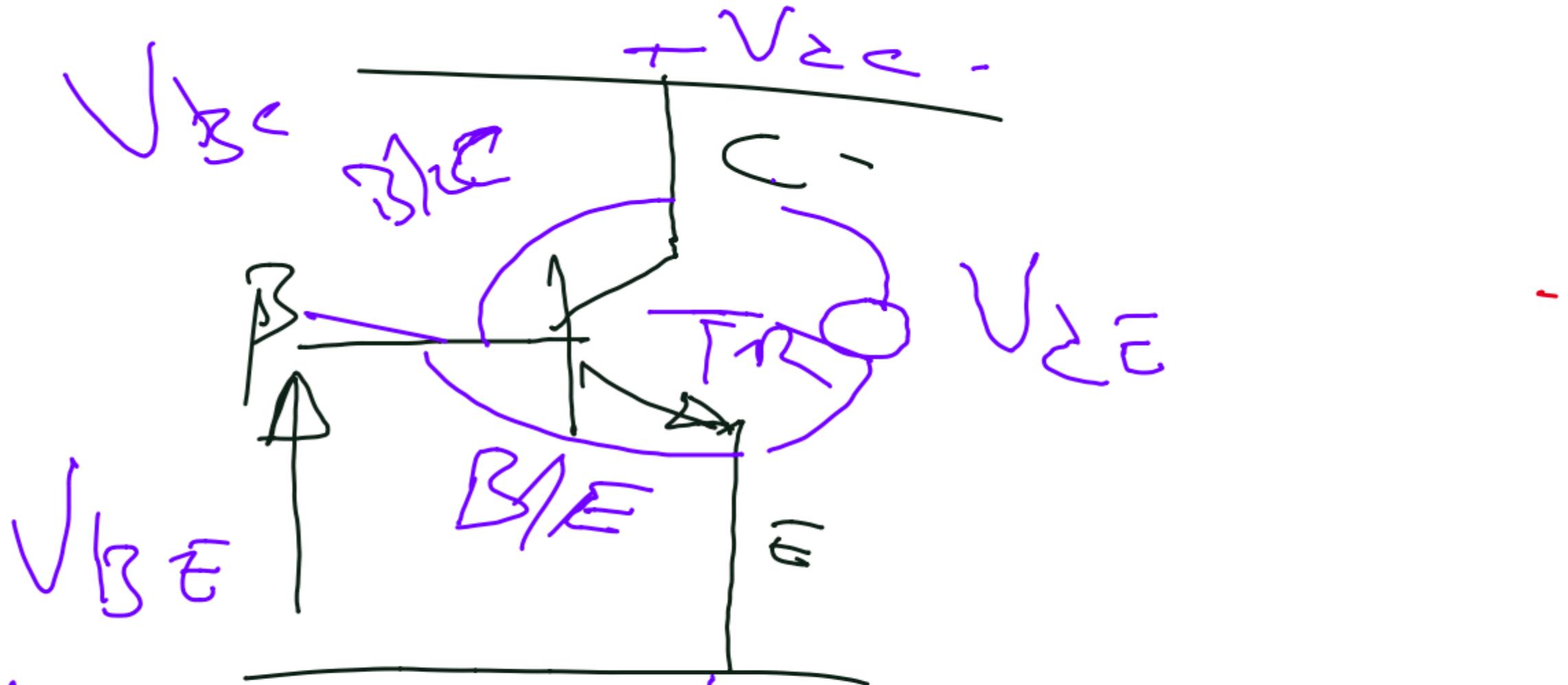
$B \leftarrow 0$

Collector  
Symbol

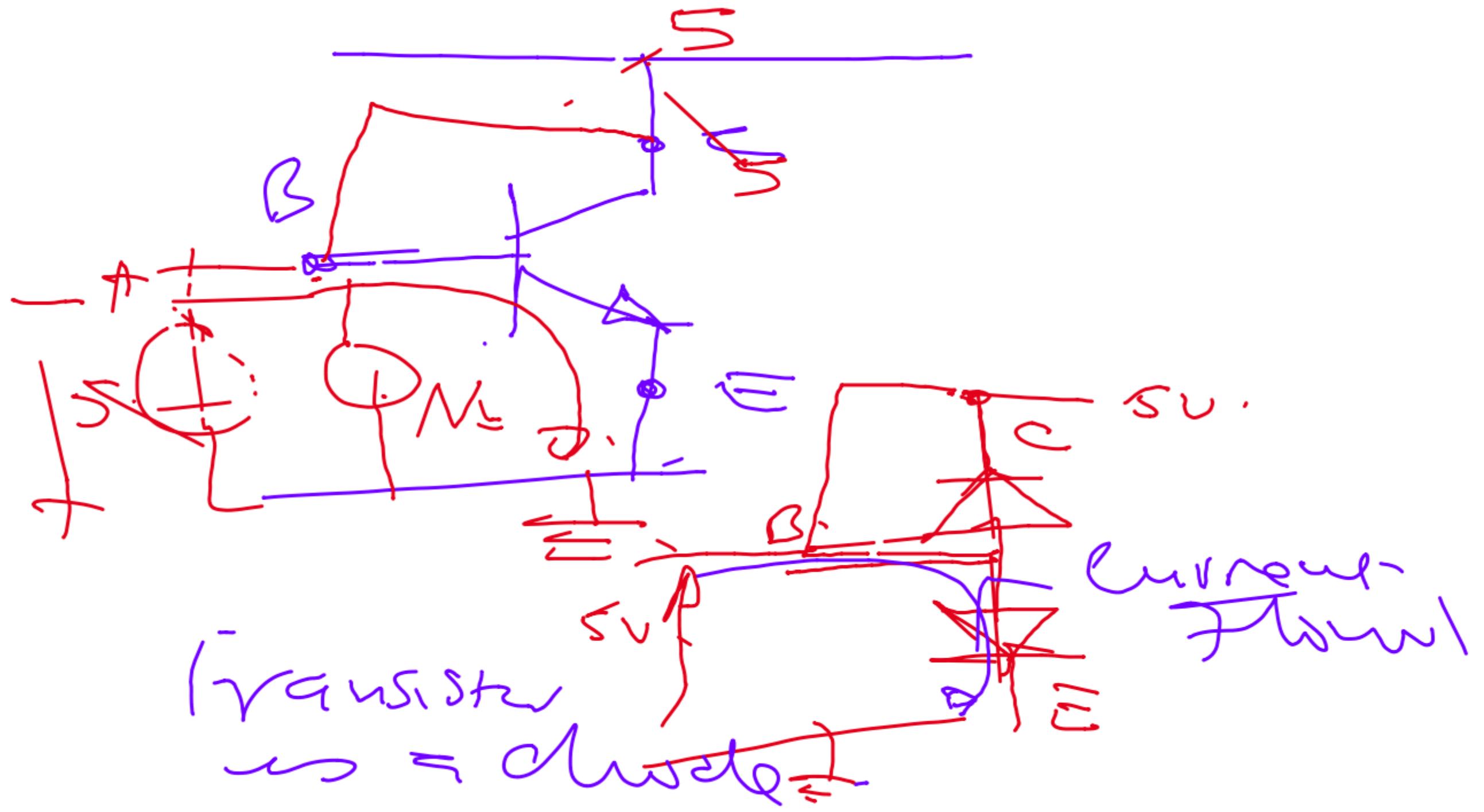
P n P  
Transistor

Emitter





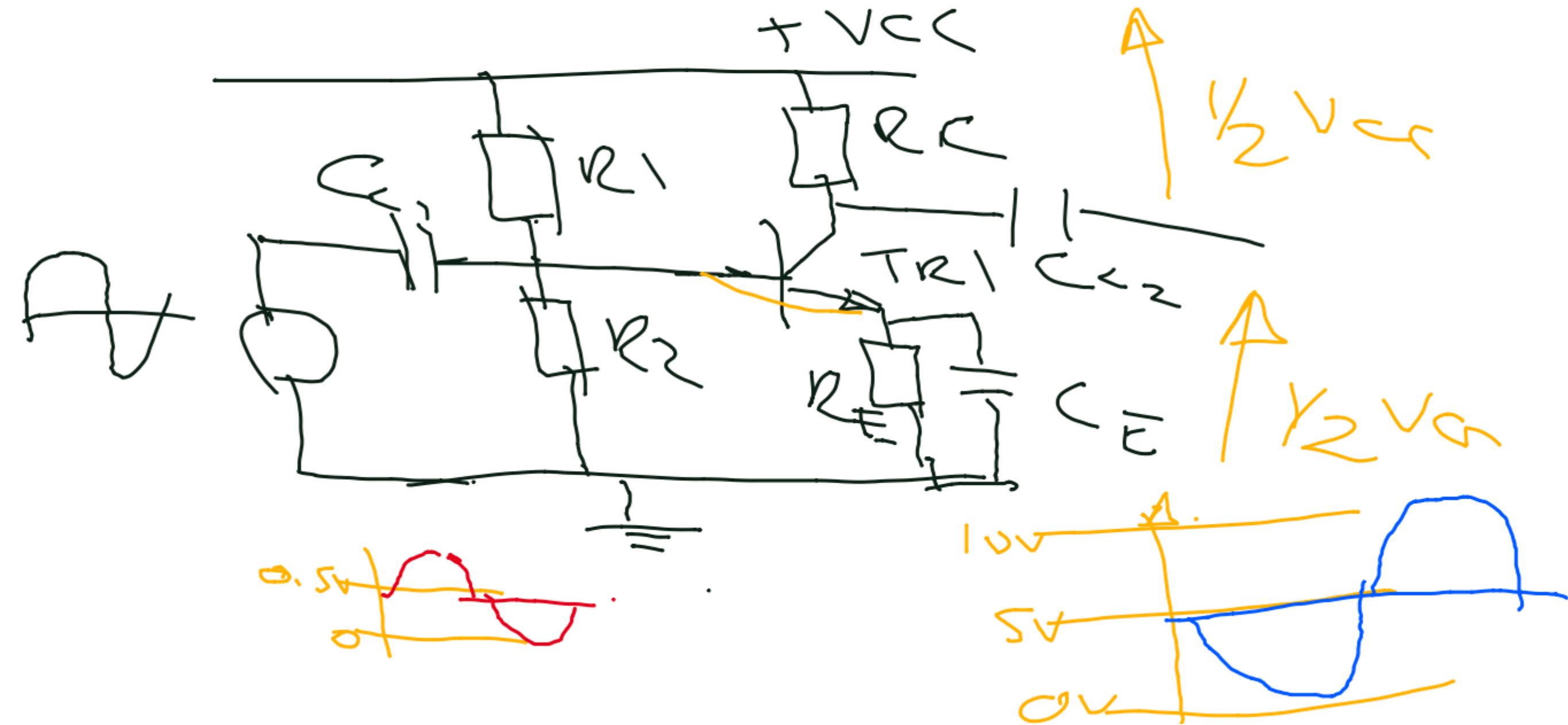
$V_{BE}$  positive  
 $V_C$  positive }  $\rightarrow$  Transistor is  
 Turned ON



When the Base of the  
Transistor is short  
circuited to the ~~base~~  
The Transistor will  
act as a diode



SILICON STAGE  
C-E. AMPLIFIER.



When the A-C signal is inputted to the Amplifier, the input-signal goes positive & it forward biases the BE junction. This allows a flowing collector current.  $I_C$  flows raising the P.D. across the collector Resistor  $R_C$ . As  $V_{RE}$  is increased the output voltage  $V_{CE}$  is reduced to zero point.

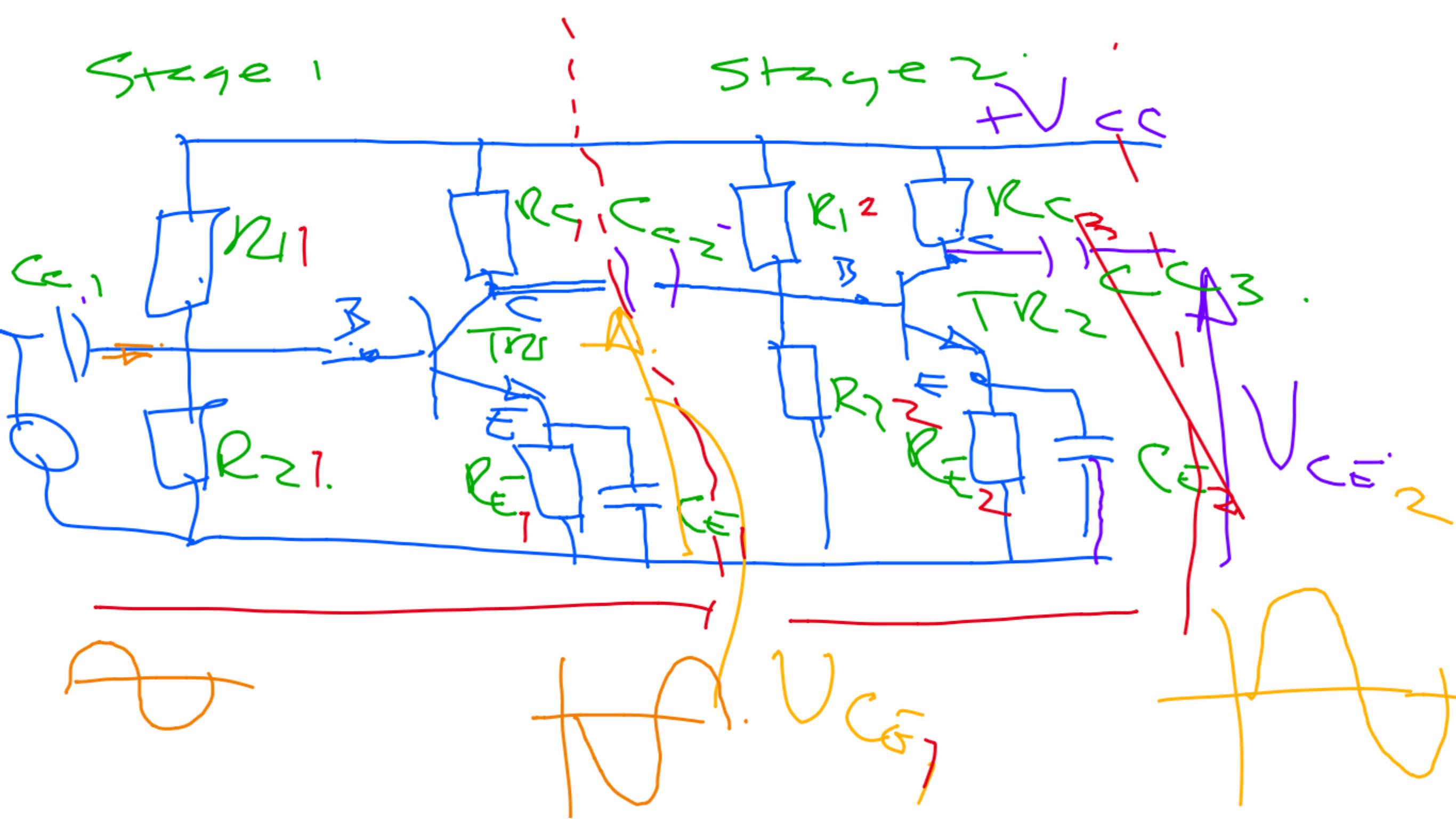
As the A-C input signal goes to the negative bias the NPN JFET  
Transistor  $T_{R1}$  is such as to be turned off so collector current  $I_C$  will drop. The  
P-A-C over the collector resistor will fall, resulting in a  
increase in the collector gate voltage which is  
the amplifier output.  
The output signal is the inverse of the

Input Signal : Two  
Single Stage Common  
Emitter Amplifier is an  
Inverting Amplifier.

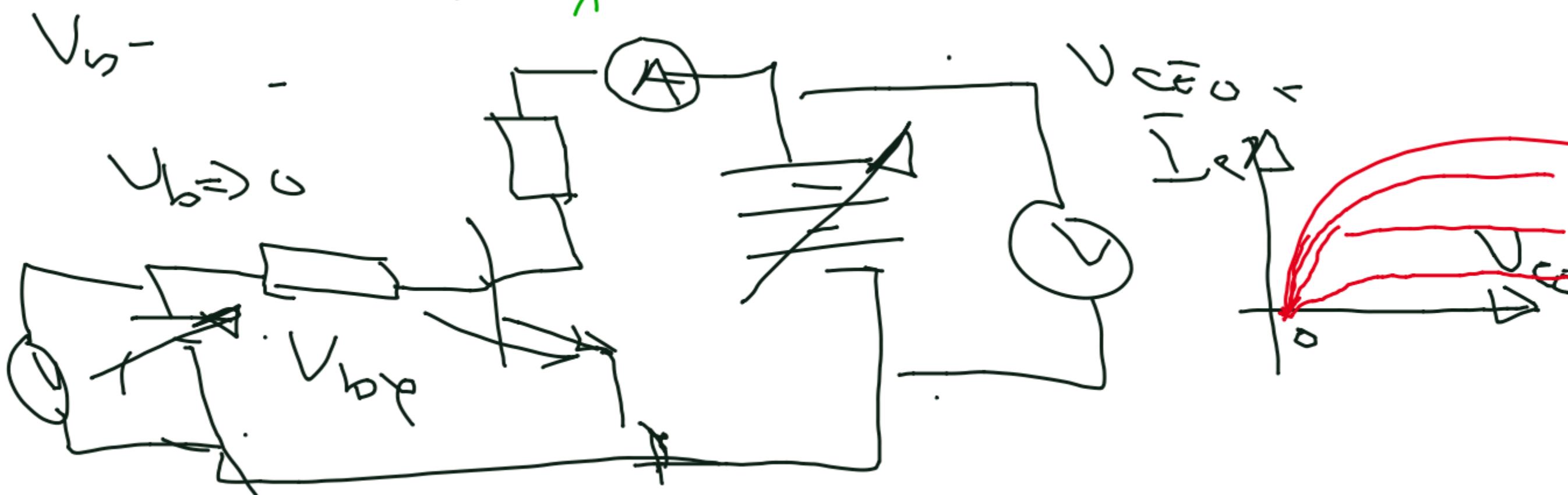


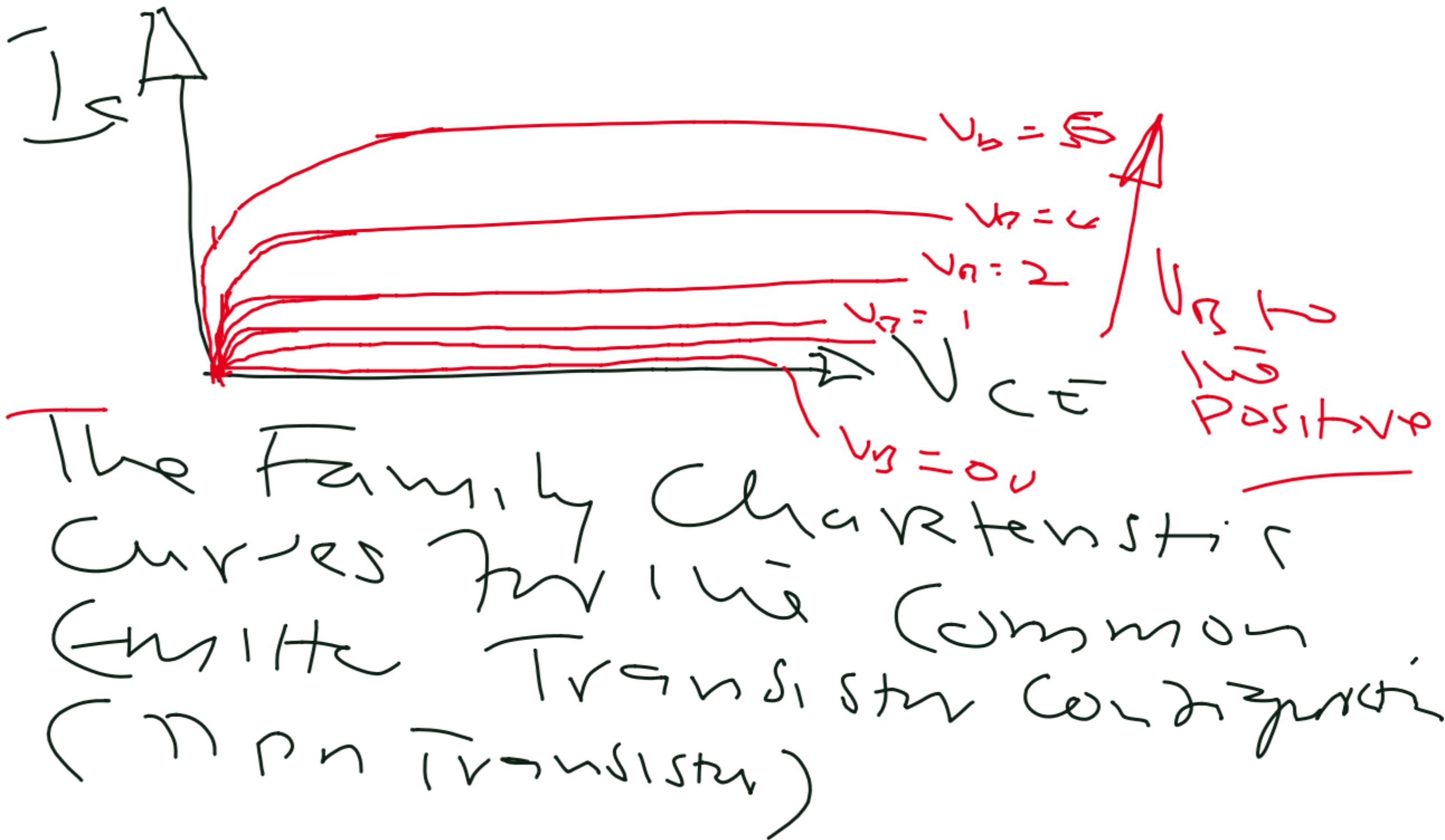
180° Phase Inversion

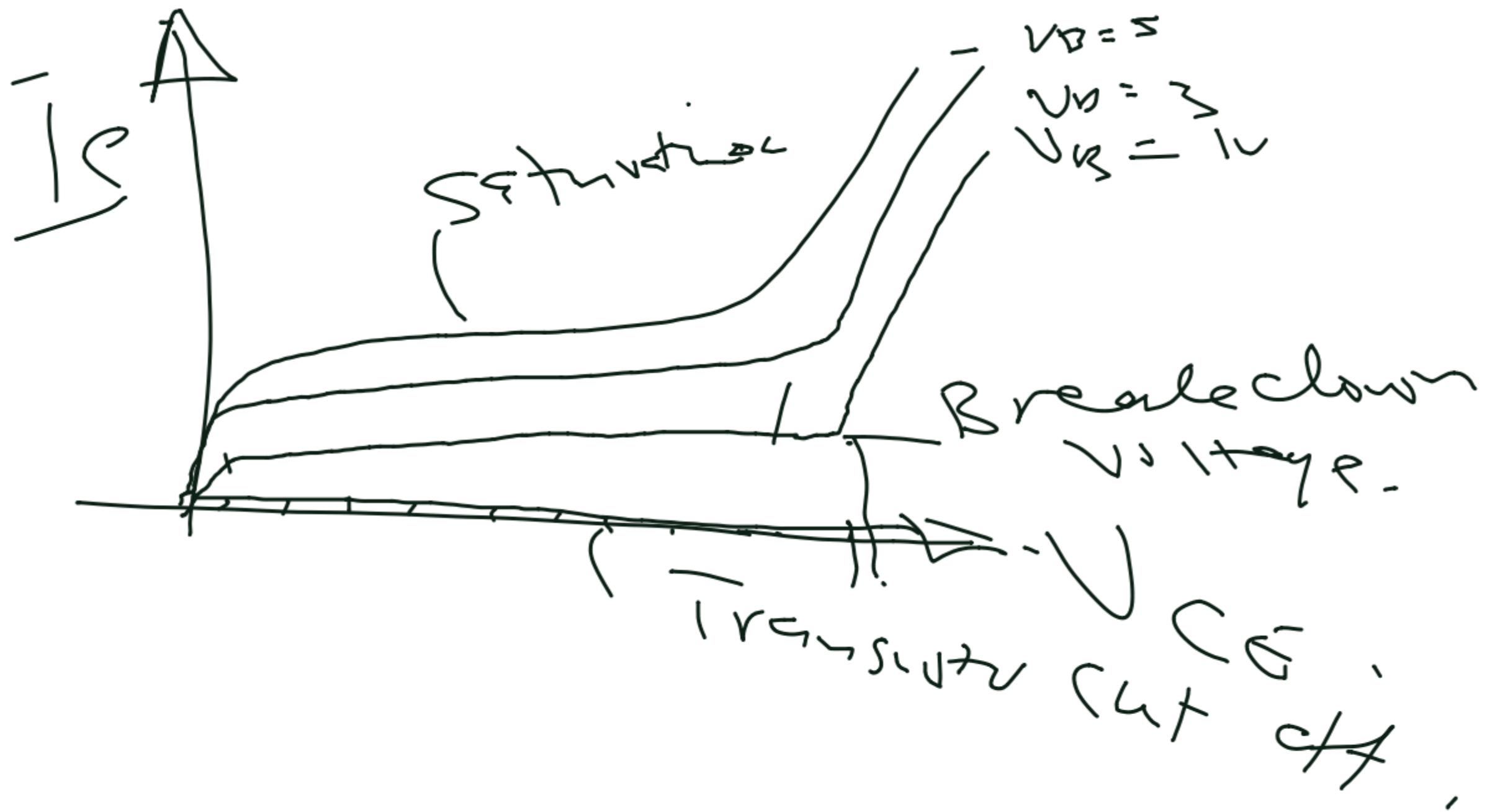




Characteristic  
Curves in  
C-E Transistor  
Configuration.







# (FIELD) EFFECT TRANSISTOR (UNIPOLAR TRANSISTOR)

JFET - JUGFET.

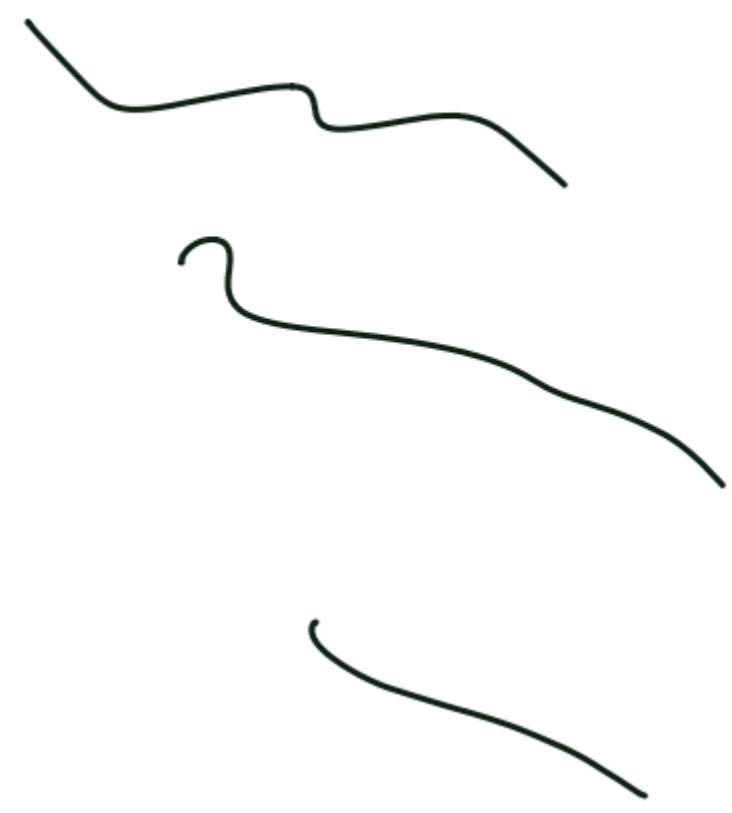
IGFET - Insulated Gate FET

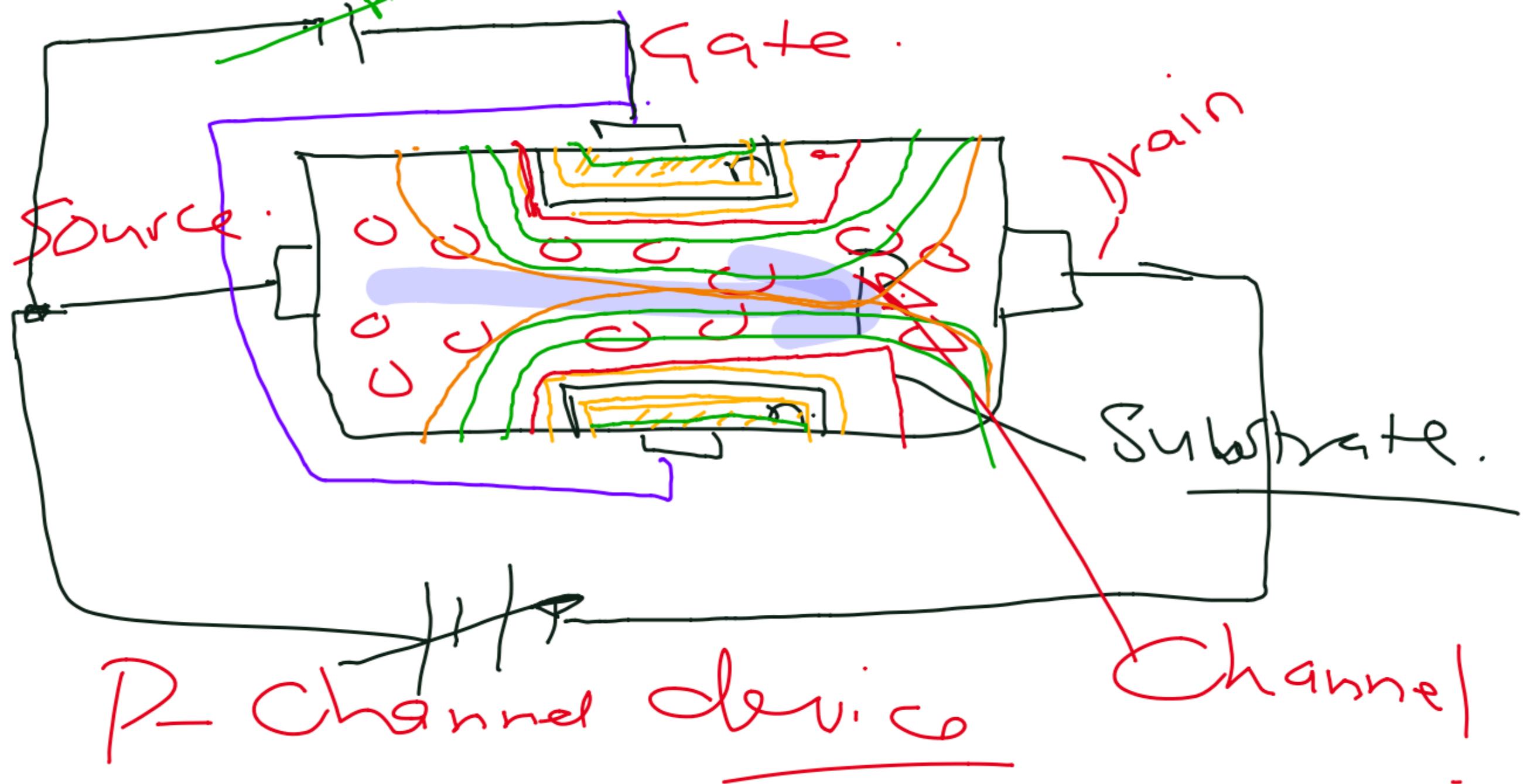
MOSFET

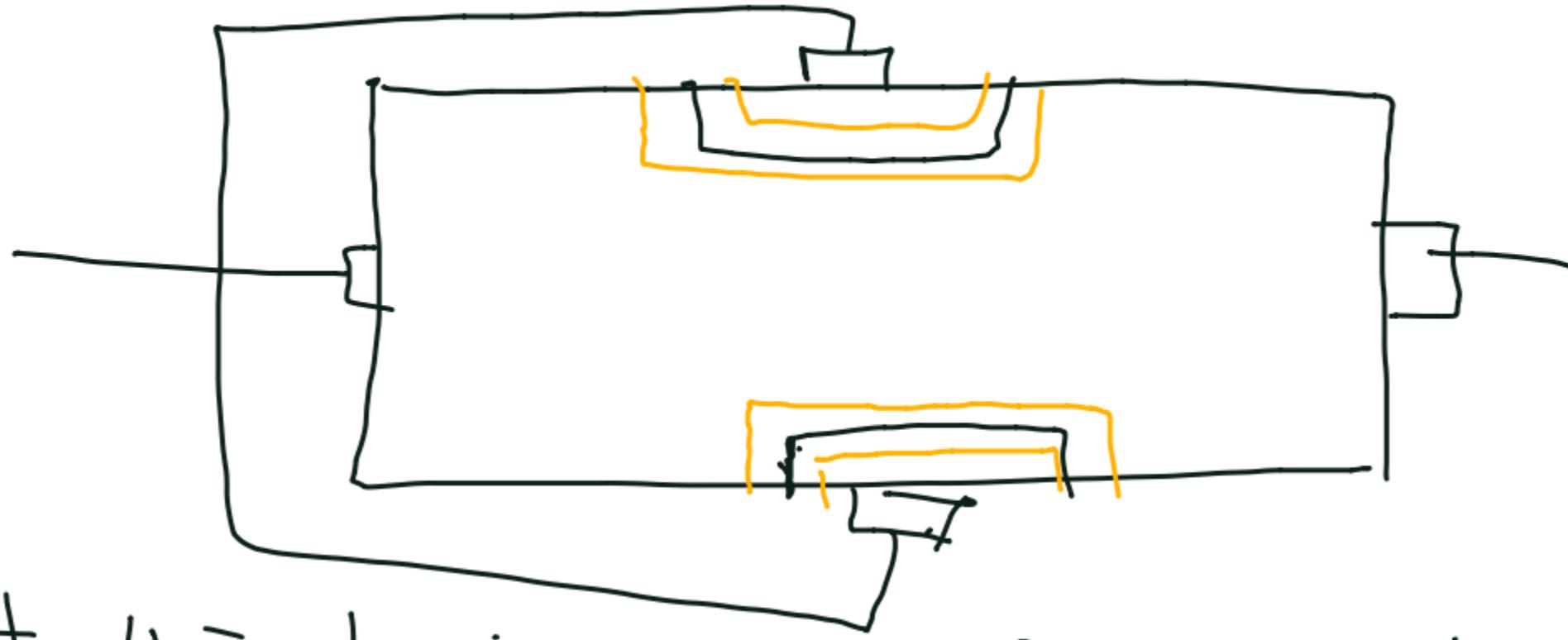
These are devices (transistors)

that are voltage controlled  
contrary to the BJT which is  
current controlled.

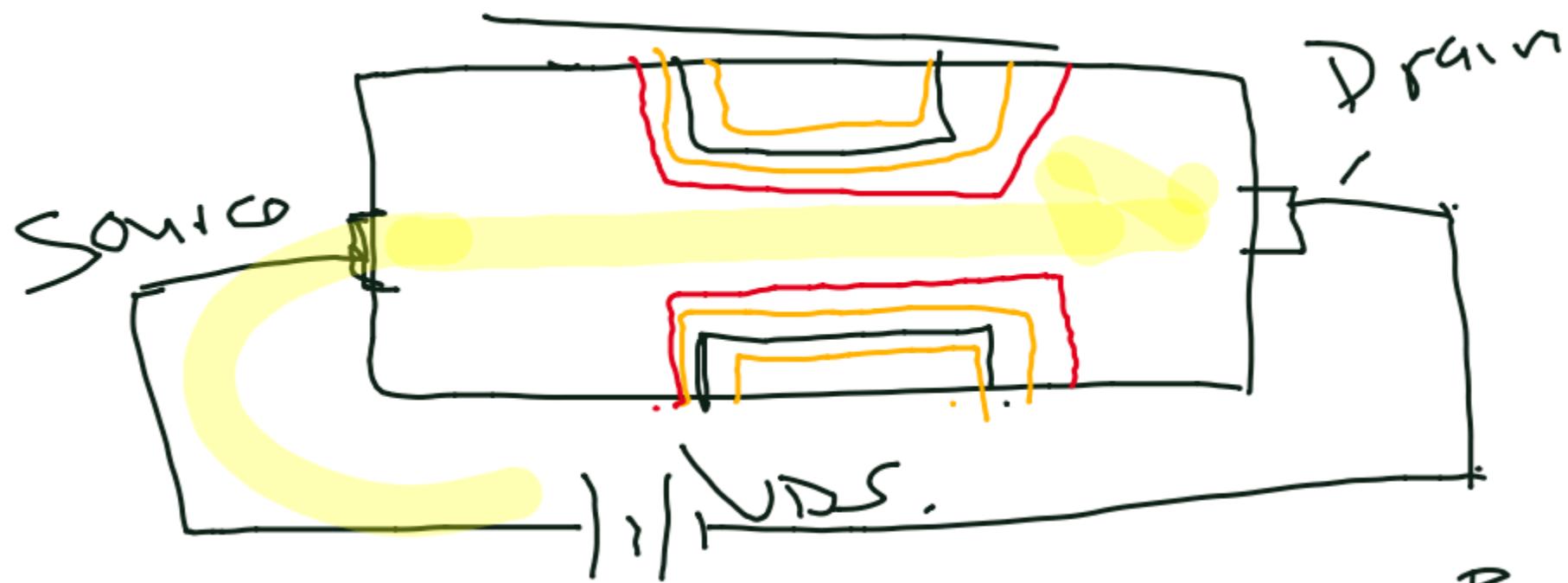
- They consume less Power compared to BJT.
- High Packing Density
- delicate to handle compared to B.J.T.







At the time of the formation, there will exist the depletion region between the P and N layers. There will be no inter exchange of charge carriers between the two materials.



When the substrate ends are Biased  
the end connected to the negative terminal  
of the source of energy will have a  
wider depletion region than the  
end connected to the positive end of  
the energy source. In between  
the depletion regions exists a  
channel that will allow current.

thus providing a path for  
the electric current to  
flow through the device.

The current in this Grant  
gives result of more movement  
of positively charged particles i.e. the  
holes. The holes and the conventional  
electric current flow are in  
the same direction in the  
channel. The channel is  
therefore referred to as P-type  
channel. Should we increase  
the V<sub>D</sub>S i.e. Drain Source Voltage

There will be a Resistant  
Increase in Drain Current  
 $I_D$ .

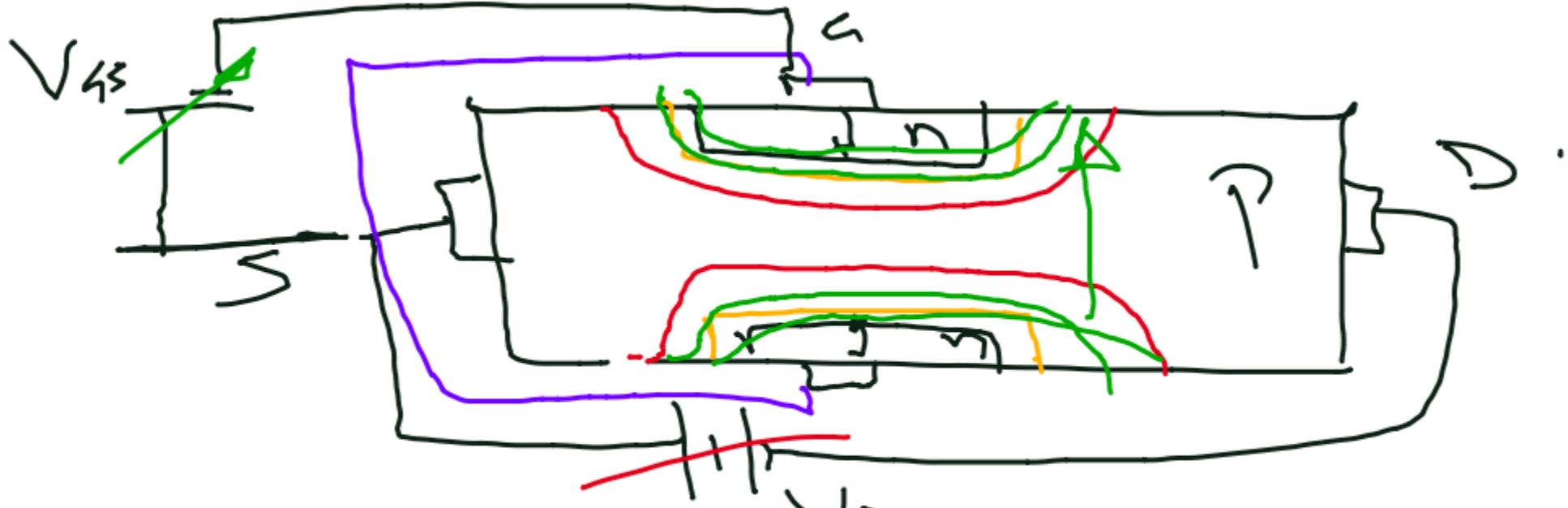
To control the Conducting  
of the channel, Voltage  $V_{GS}$   
i.e Gate Source Voltage is provided  
such that the Gate is positive  
with respect to the Source.



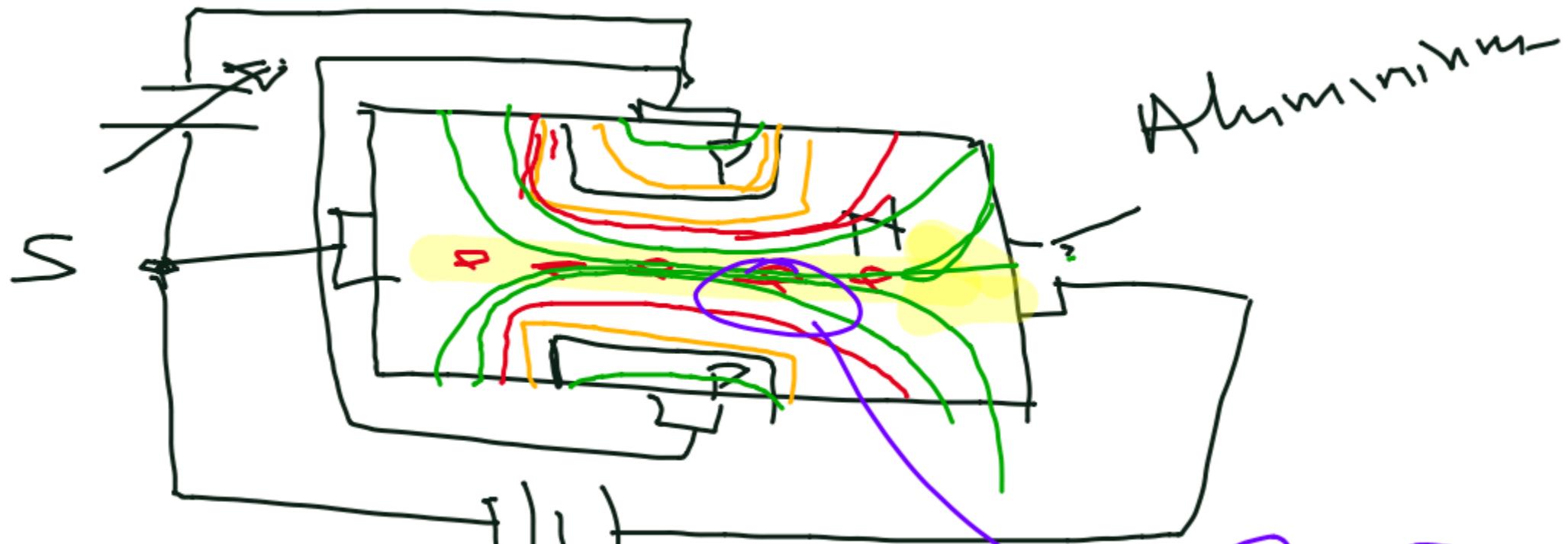
As  $V_{GS}$  is increased to the positive, the depletion regions increase in width (extending into the conductor channel).

The transistor is said to be cut-off

Continued increase in the  
V<sub>AS</sub> to the positive will  
result in the two  
depletion layers touching  
each other. Therefore terminating  
the existence of the Conducting  
Channel. The Channel will have  
been depleted of the Charge carriers  
therefore said to be Cut-off.  
The device is thus said to be operating  
in the DEPLETION Mode.



When  $V_{GS}$  is negative with respect to  $V_{DS}$ ,  
 The depletion region is reduced at the  
 P-n junction thus increasing the  
 conductivity of the channel by  
 providing more holes to  
 participate in the conduction of  
 the drain current. This results  
 in an ENHANCED P CHANNEL.



The channel here is made of N-type material hence the electrons move in the channel. The charge carriers in the channel.

The two depletion layers will touch each other thus eliminating the conduction path (Channel). The drain will be

Upon connecting the Positive terminal of the energy source to the Drains of the Transistor and the Negative terminal to the Source of the Transistor the depletion regions to the Drains of the transistor will be enlarged more than to the Source thus the Channel ( $N$ ) get narrower to the Drain terminal as compared to the Source terminals. The Channel is a Variable for Conducting Electric Current. Thus the

The Drift of electrons from the Source to the Drain. Take note that there is no Gate Current -  $I_g$ . flowing into the channel or out of the channel. The conventional electric current is said here to be flowing from the Drain to the Source (P. Dr. Current  $I_D$ ). To control the conductivity of the channel the Gate/Source Voltage  $V_{GS}$  is provided such as to increase

The Gate Negative with respect to the Source.

The depletion region in the device will increase thus reducing the size of the Conduction Channel until further increase to depletion layer will converge at a point thereby cutting OFF the Conducting Channel. This N-channel Device is said to be OPERATIONAL.



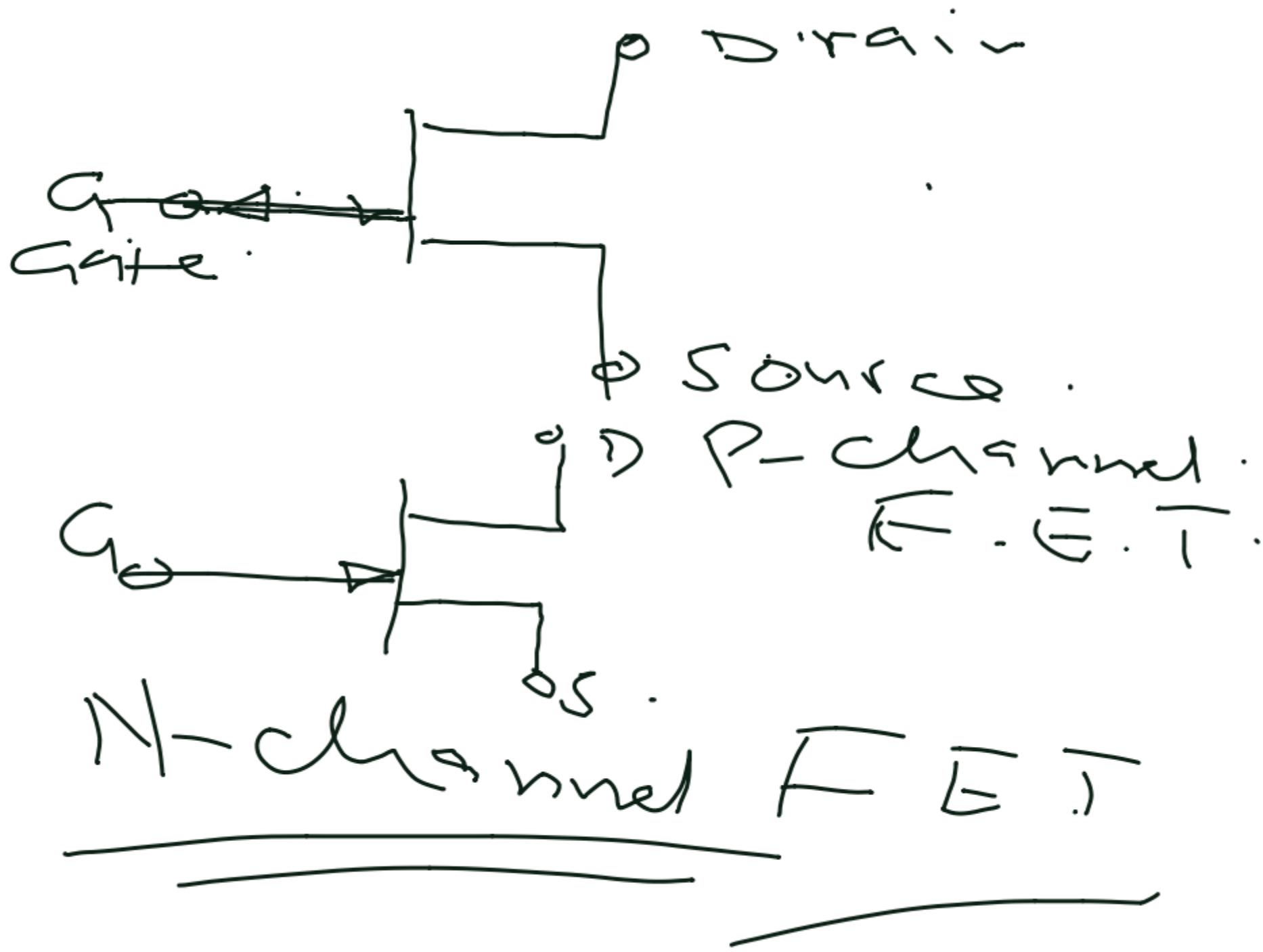
As  $V_{GS}$  is increased to its positive depiction layers within the channel and reduced thus increasing the conductivity allowing more current to flow.

*Conventional  
electric circuit*

# Electronic Circuit Symbols for the

T. G. i. Transistor.

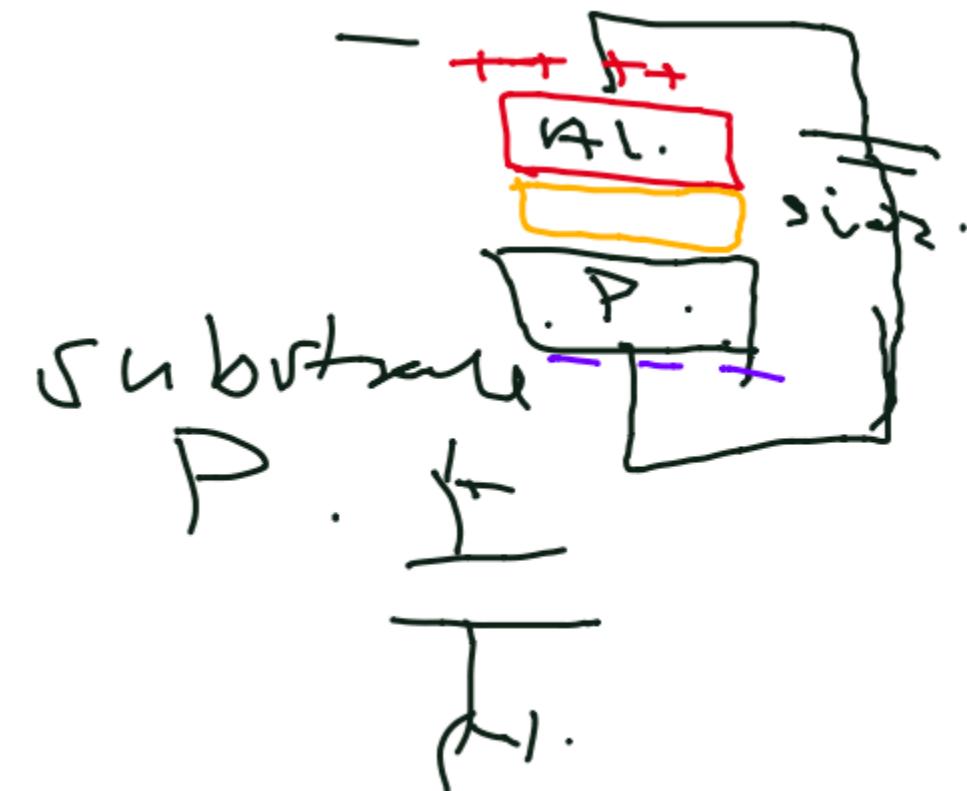
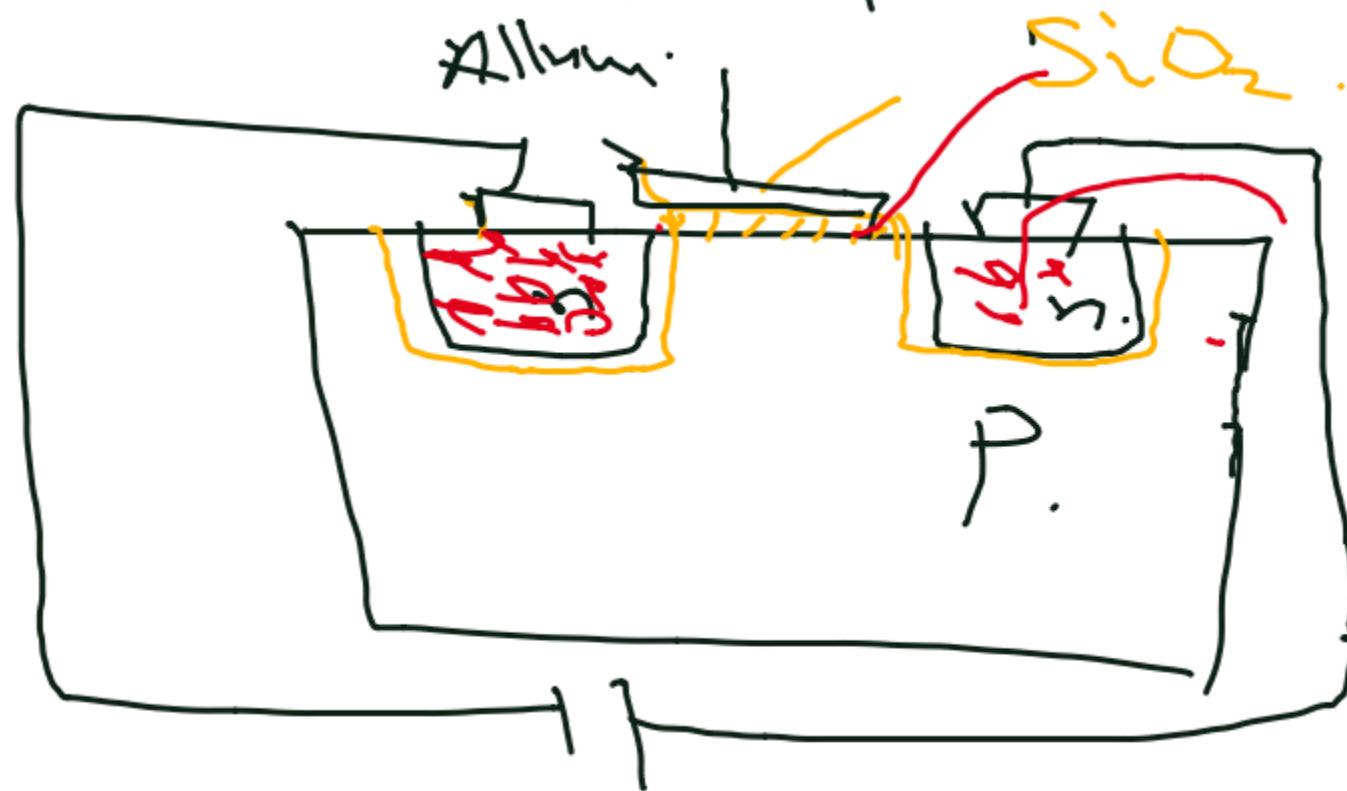


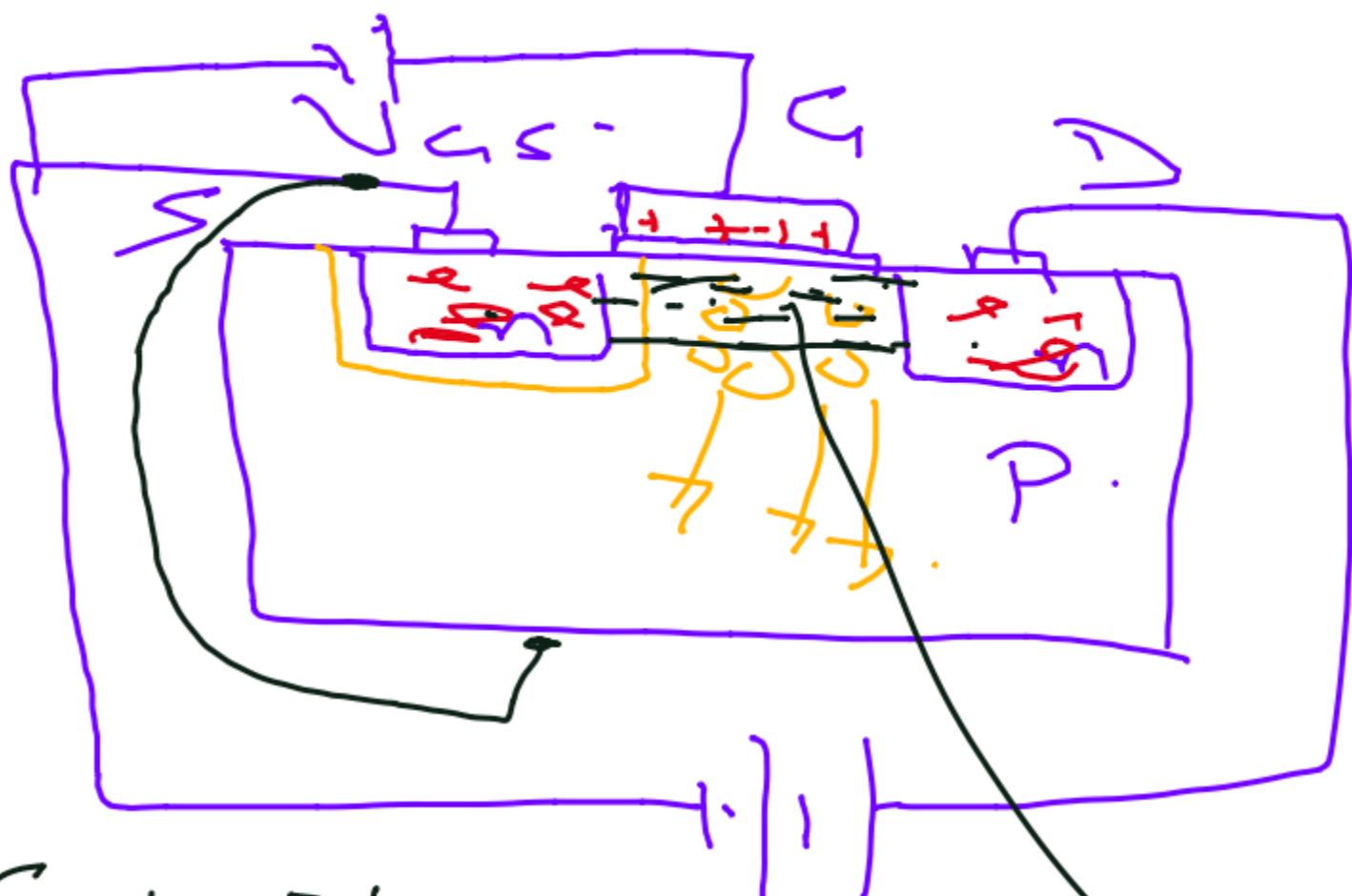


I G FET

MOSFET

Metal Oxide Semiconductor  
F - E - R





The Gate Plate  
which is placed  
is placed on top  
the Silicon dioxide  
layer which is above  
the substrate.

Channel  
created  
N-channel.

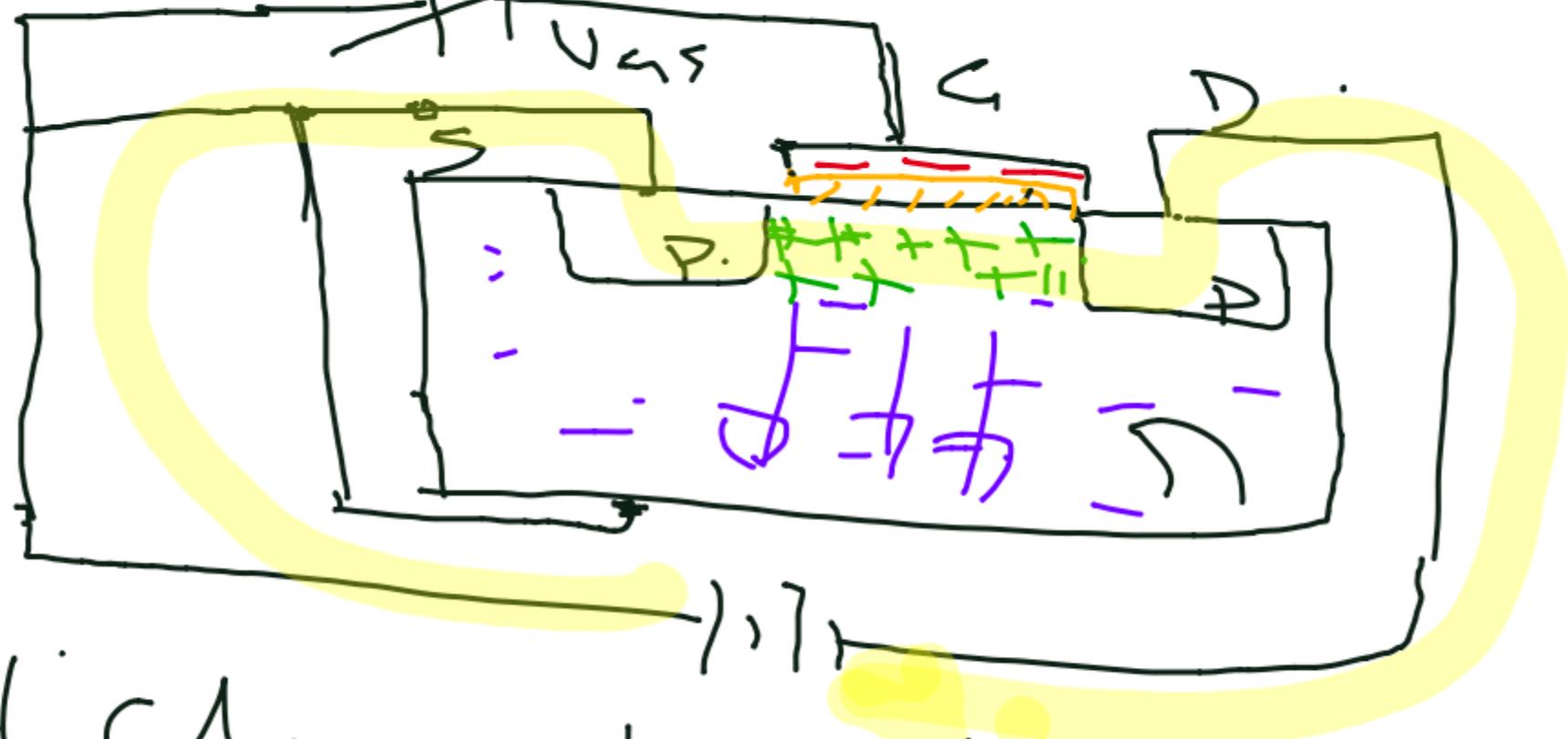
The combination of  
the three form  
of precipitor. When the  
metal plate is connected to the  
positive terminal of  $V_{GS}$  and  
the P-substrate is connected to  
negative. The portion directly under  
gate plate will assume negative  
polarity as the gate plate is  
made positive. The negative

Polarizing Created Under  
The Gate is the  
M-channel Then Will  
Connect the Source to the  
Draining this Transistor.  
Enhanced Where the two  
Terminals were isolated.



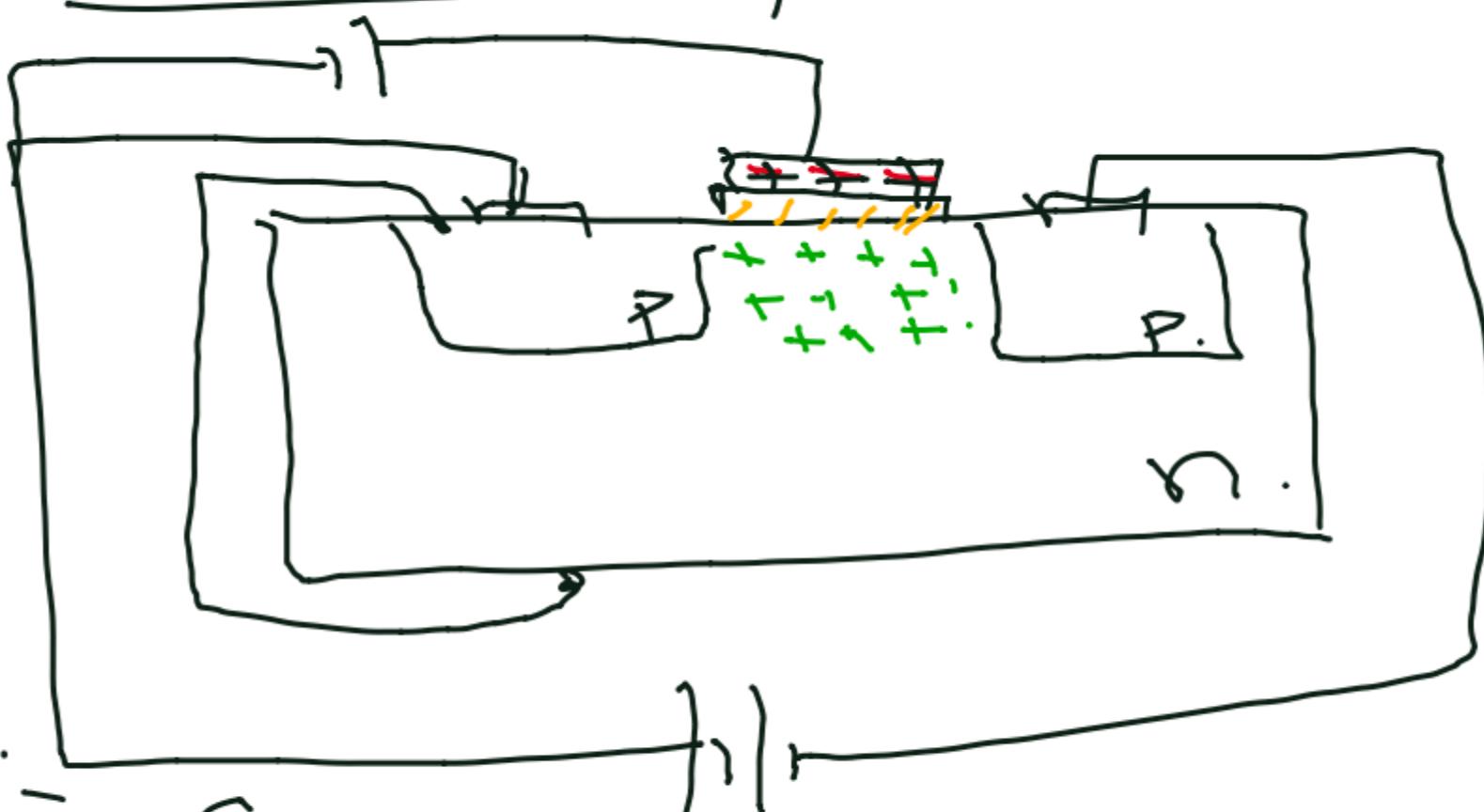
New channel  
created.

P-Channel



N-channel Enhancement-type

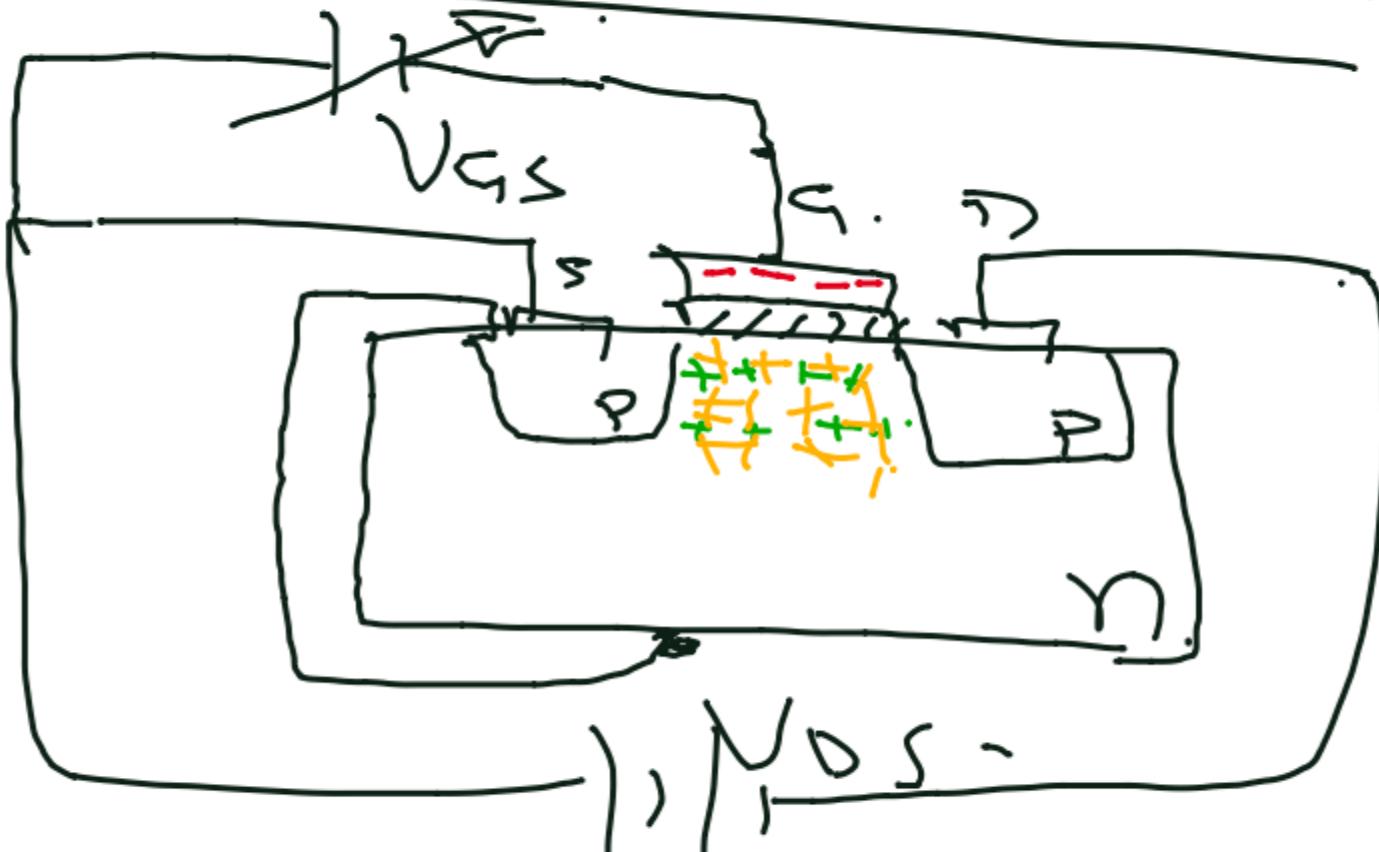
# Depletion-type MOSFET



As the Gate terminal is made Positive with respect to the Source. The Gate Substrate portion under it becomes

Negative Polarity thus  
Introducing electrons  
into the otherwise largely  
charged P-channel. The  
negative charges will consume  
the free holes leaving the  
channel depleted of holes.  
The mode of operation in this  
configuration is therefore referred  
to as DEPLETION MODE

## Enhancement Mode



Depletion type MOSFET. P-channel.

# Echomeric Symbols Circuit

