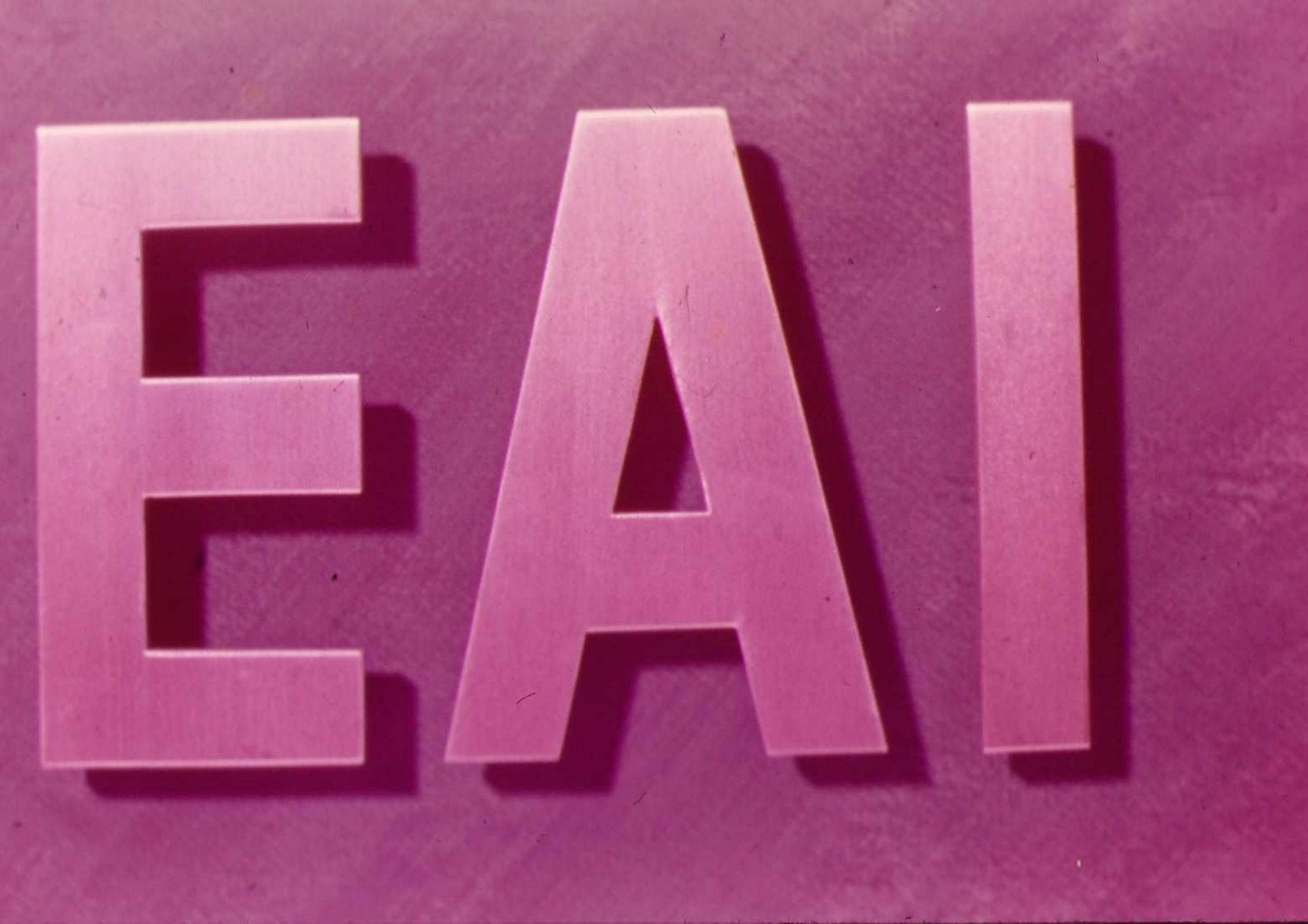
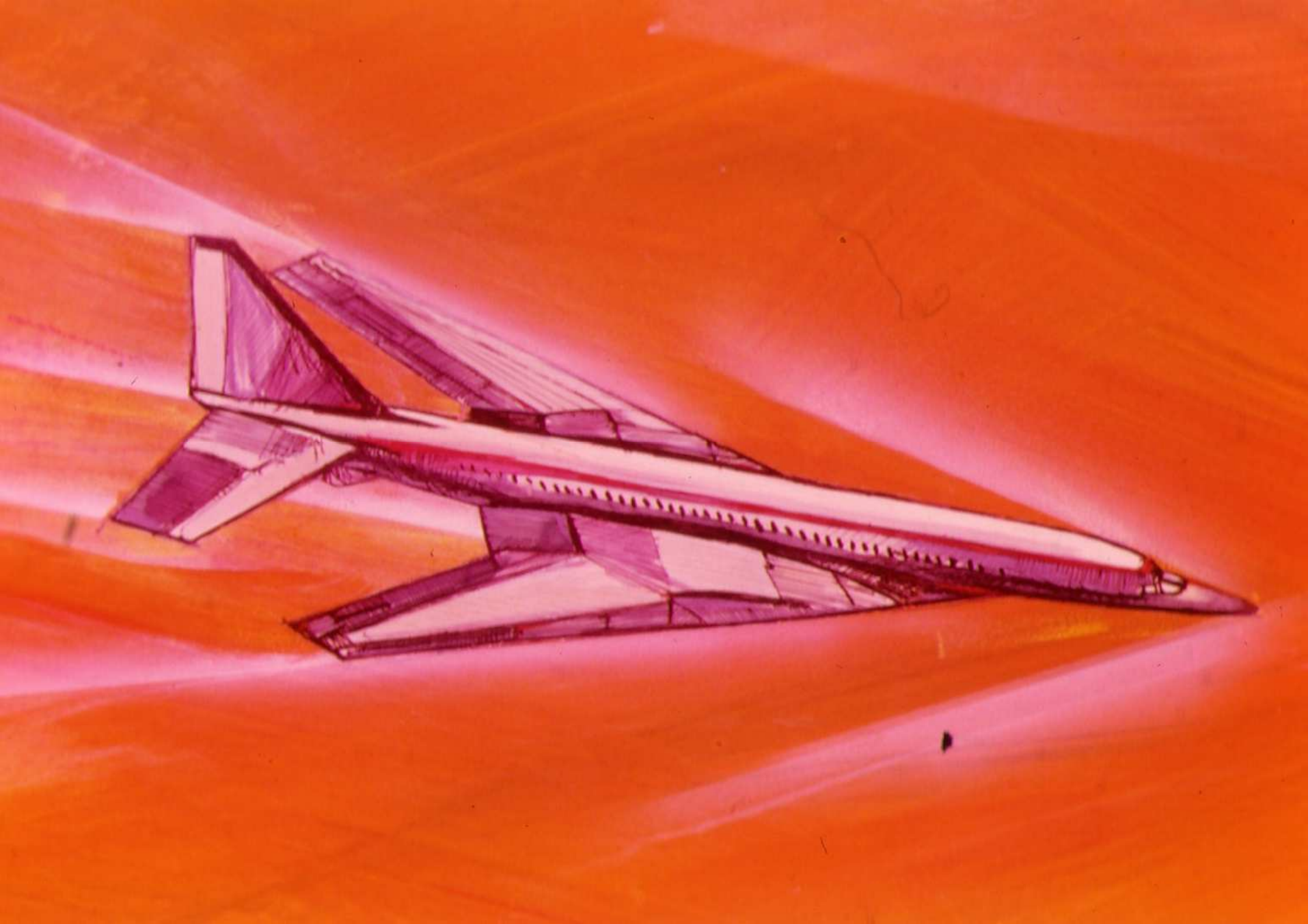

EAI

Education & Training Department

ELECTRONIC ASSOCIATES, INC.

West Long Branch, New Jersey

Understanding the ANALOG/HYBRID Computer




EMERGENCY
REACTOR #1

THESE EXTRAORDINARY EVENTS

ARE BEING REHEARSED DAILY

UNDER ALL POSSIBLE

CIRCUMSTANCES....

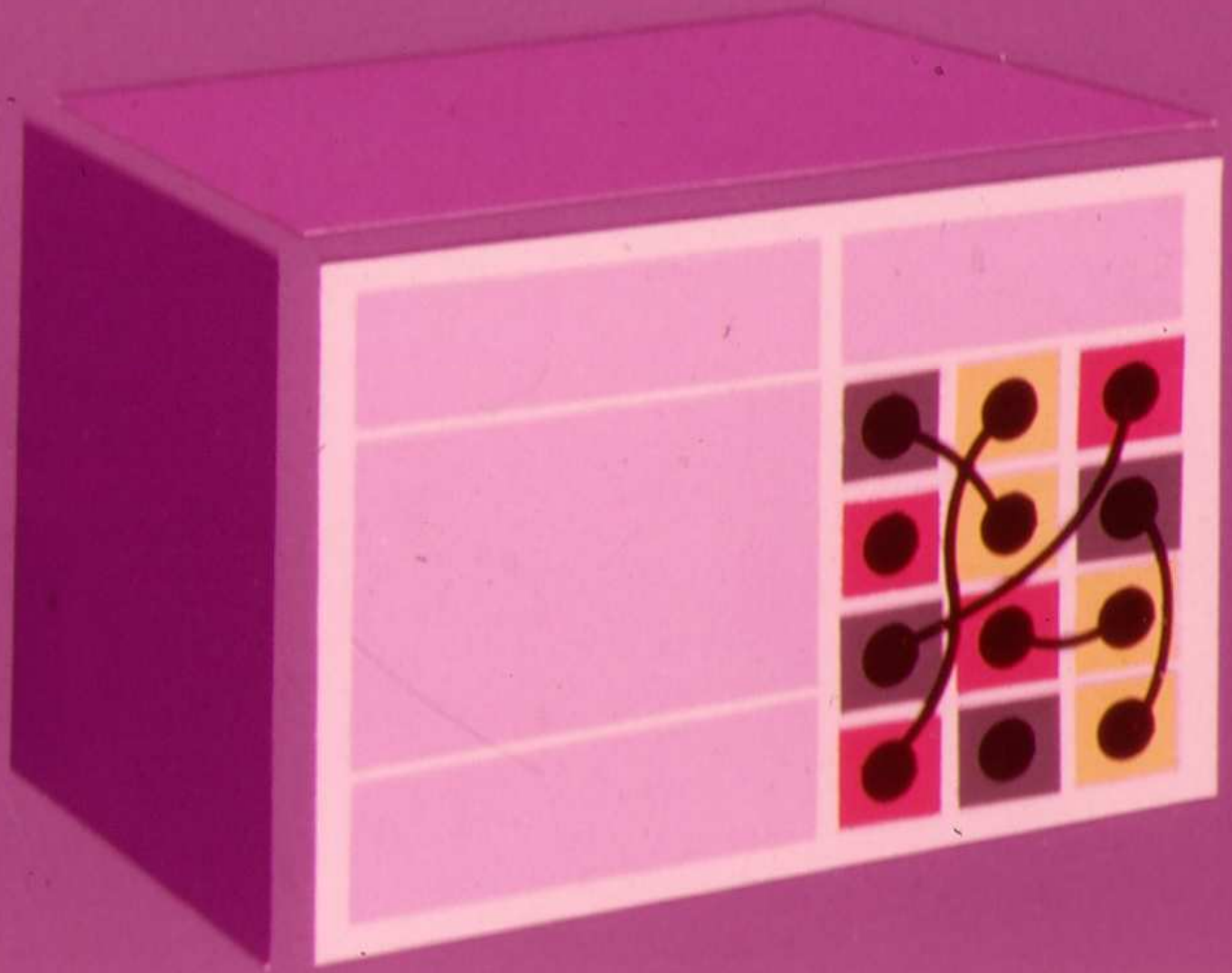
..... ENGINEERING DESIGNS ARE

BEING MODIFIED AND PERFECTED

---QUICKLY, ECONOMICALLY, AND

SAFELY, THROUGH THE USE OF....

The ANALOG/HYBRID Computer



1.

What is an Analog/Hybrid computer?

2.

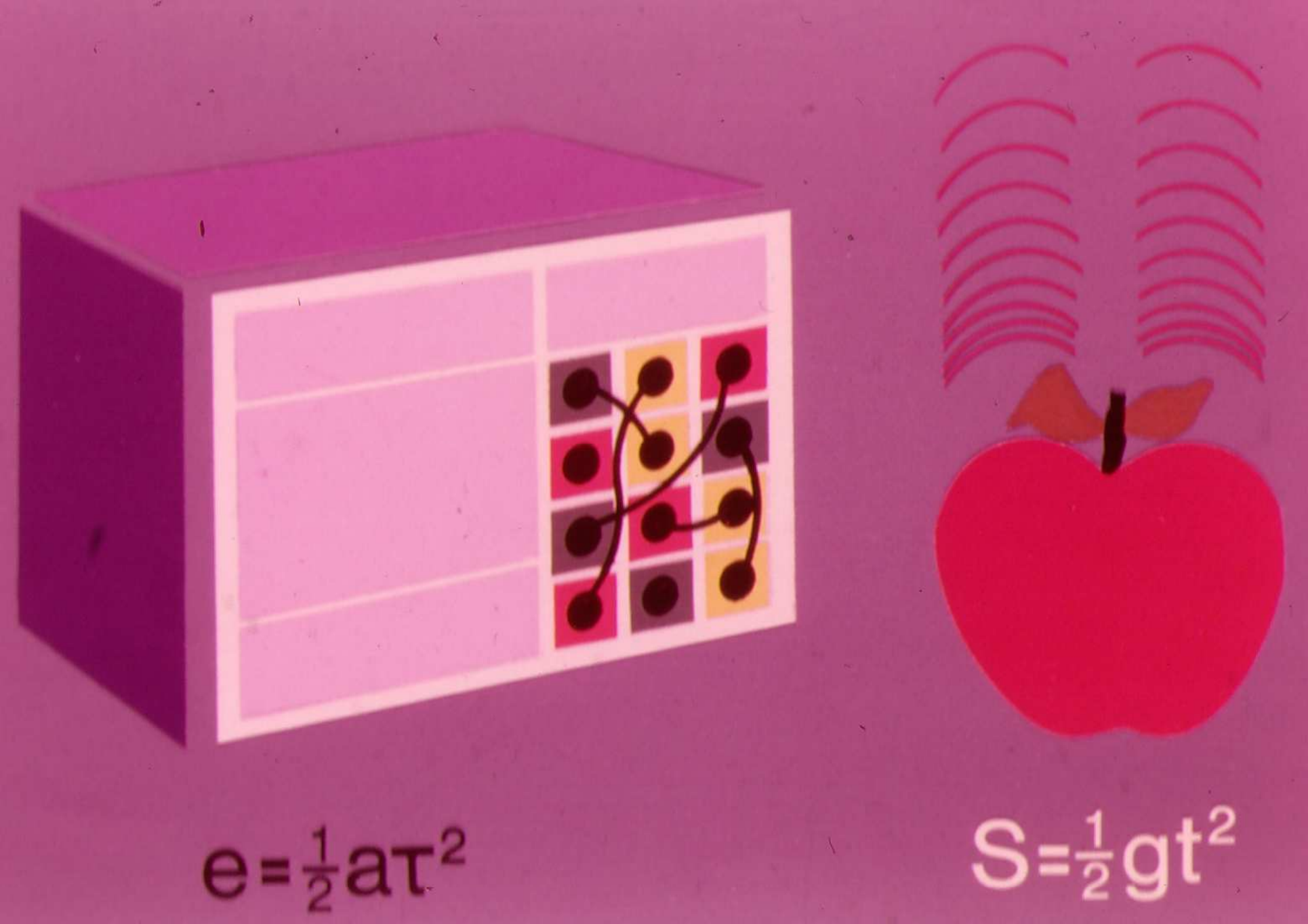
How and where is it used?

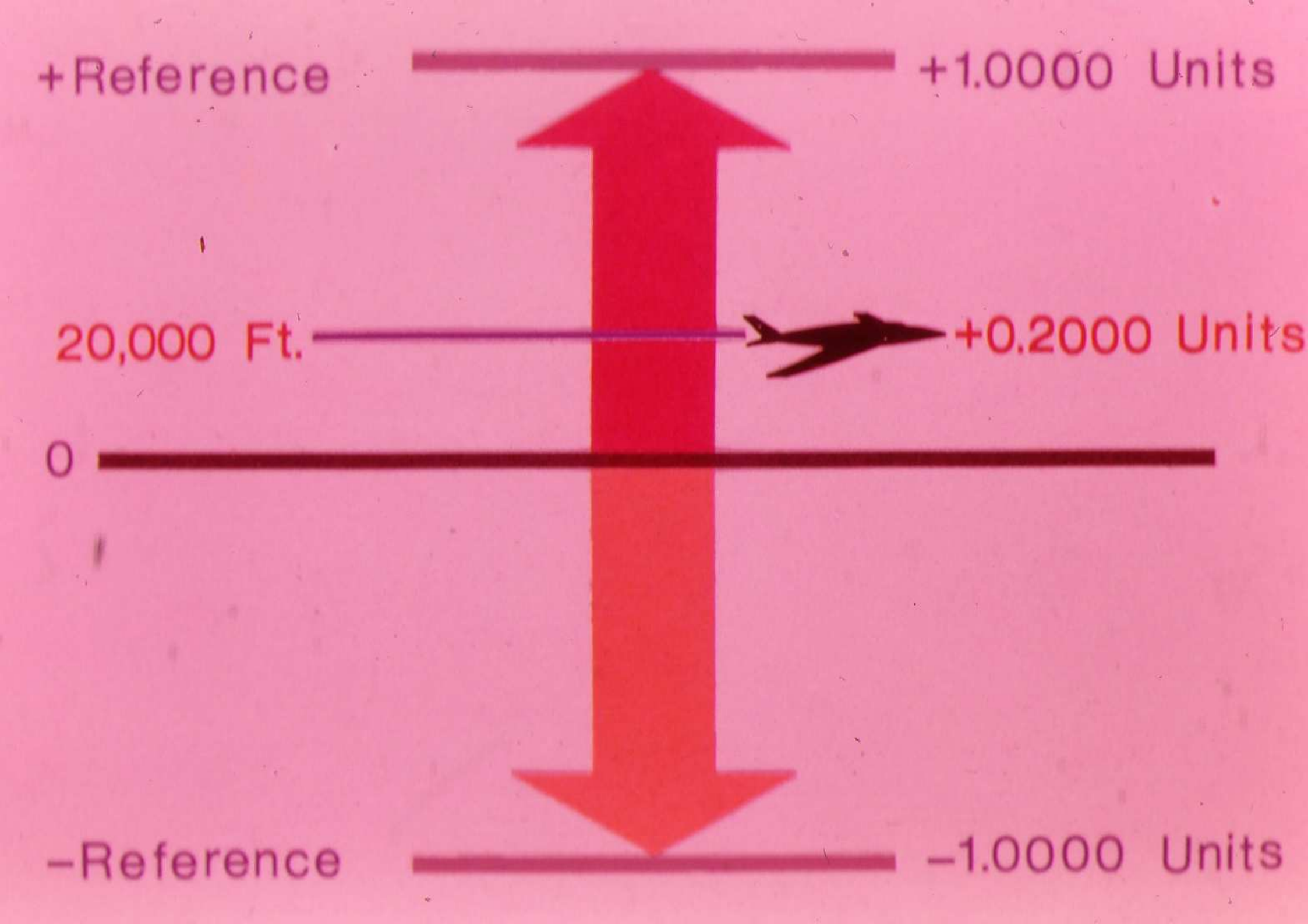
3.

How does it compare with other types of computers?

ANALOG COMPUTERS
SOLVE PROBLEMS BY

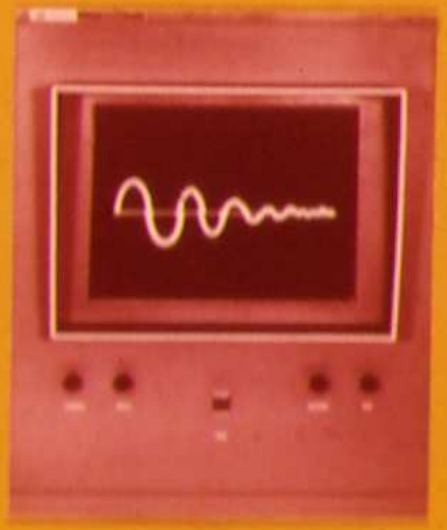
SIMULATION


$e=\frac{1}{2}a\tau^2$
$S=\frac{1}{2}gt^2$

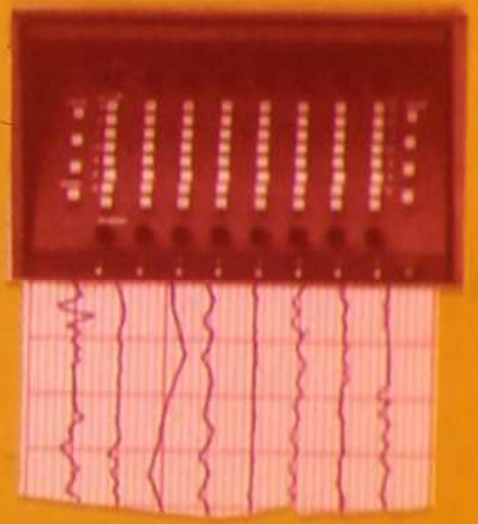

+Reference
+1.0000 Units
20,000 Ft.
+0.2000 Units
0
–Reference
–1.0000 Units

Digital Voltmeter

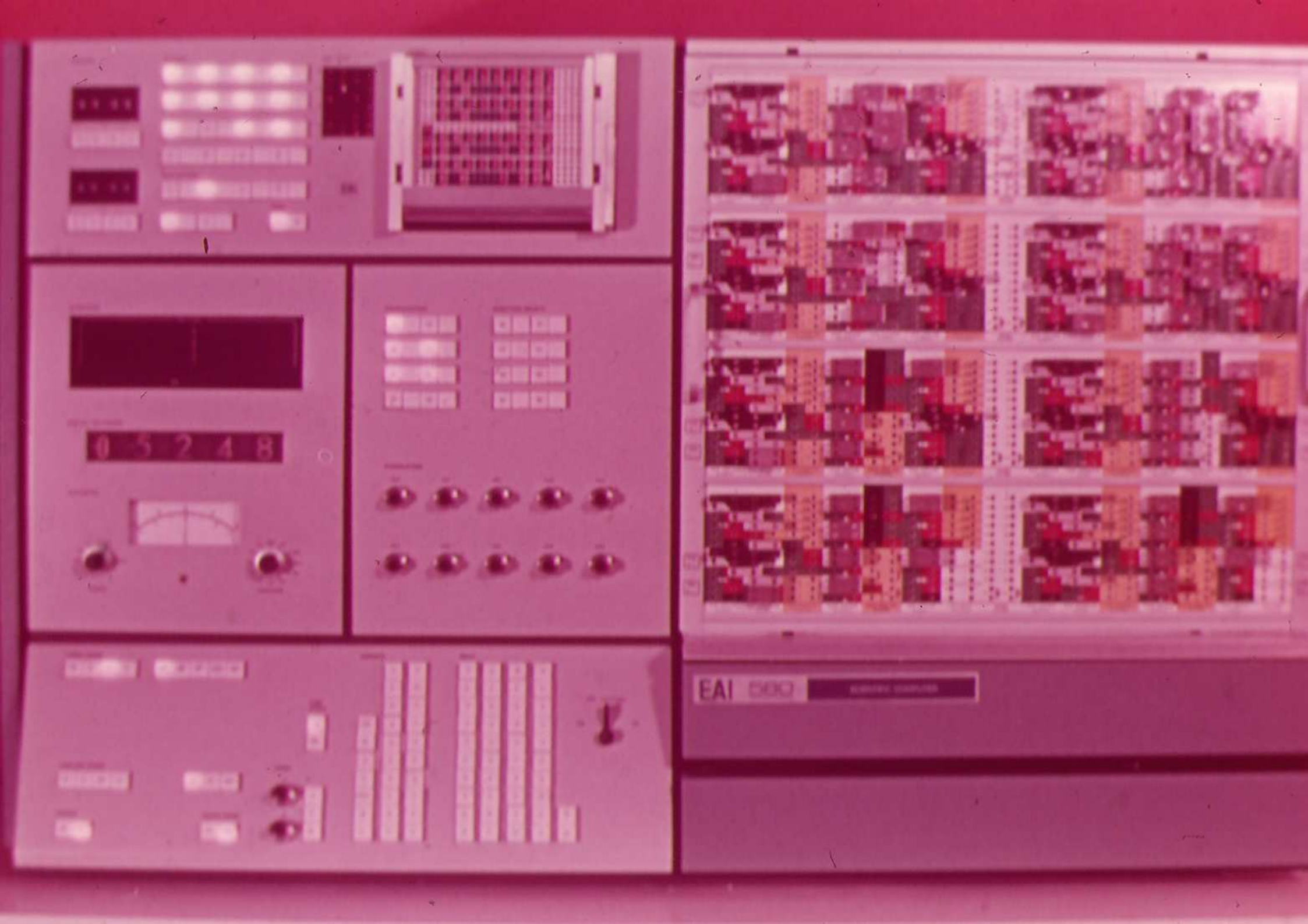
X-Y Plotter



Display Scope



Recorder


EAI

1. Summers

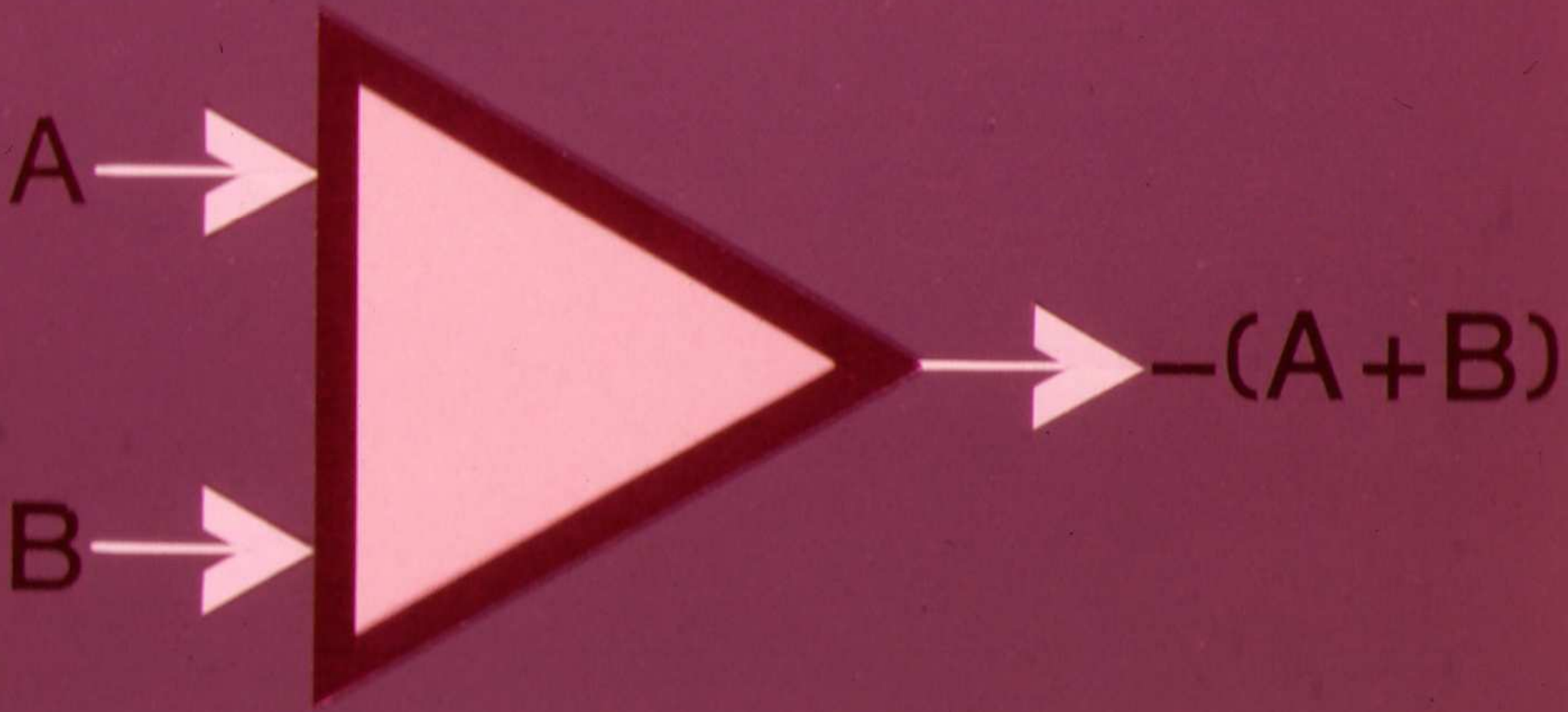
2. Multipliers

3. Potentiometers

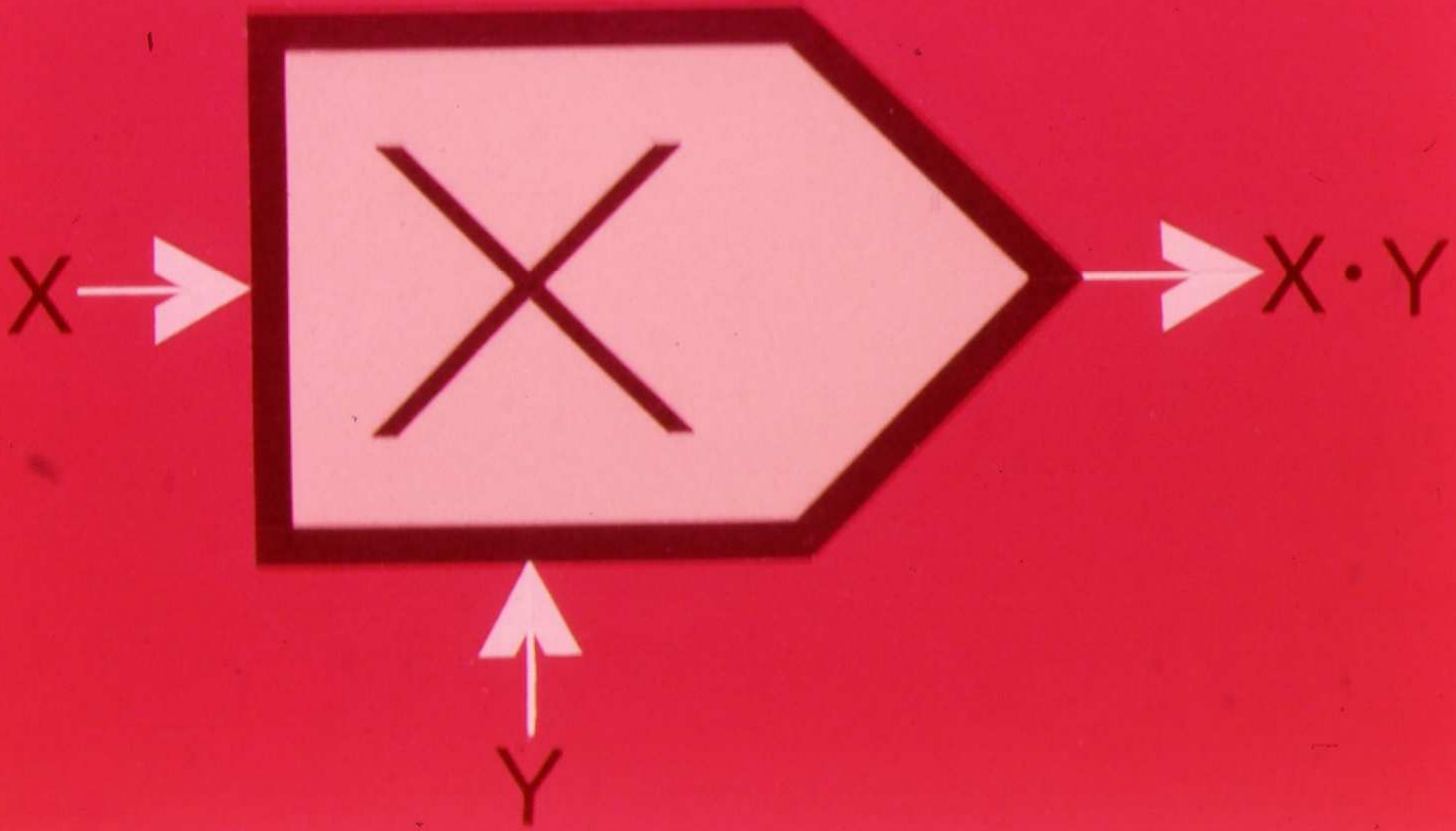
4. Function Generators

5. Integrators

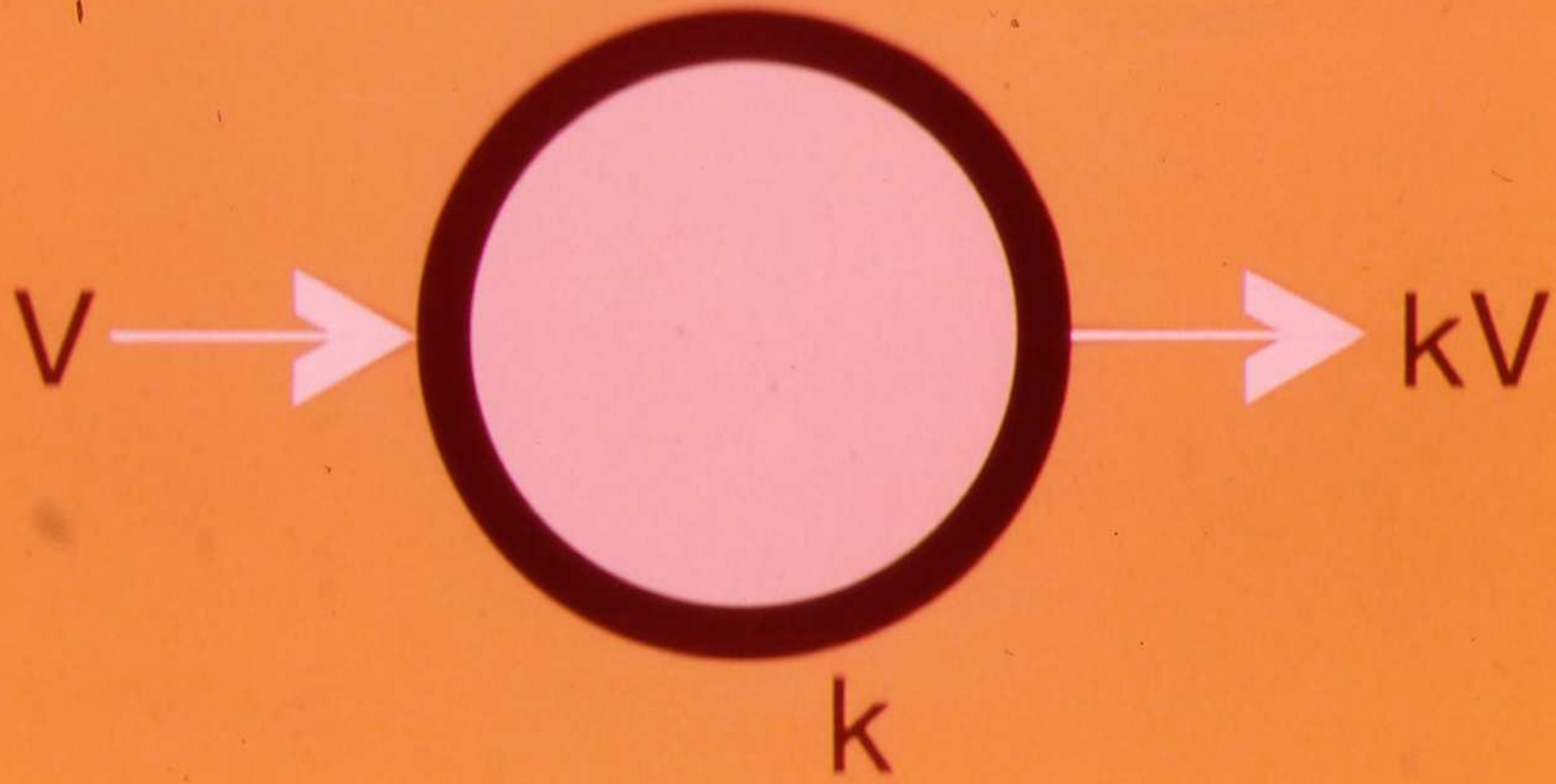
SUMMERS

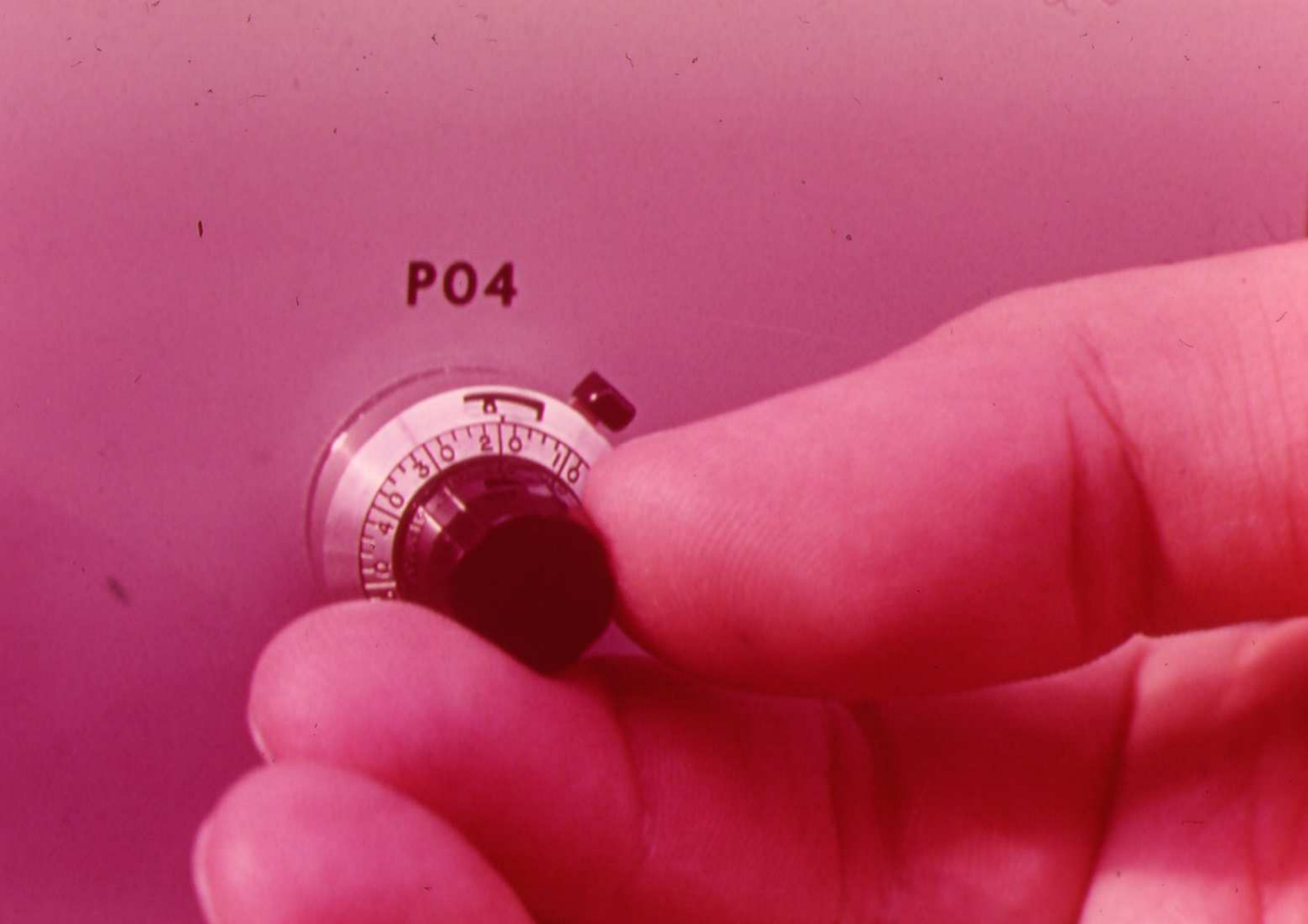


MULTIPLIERS

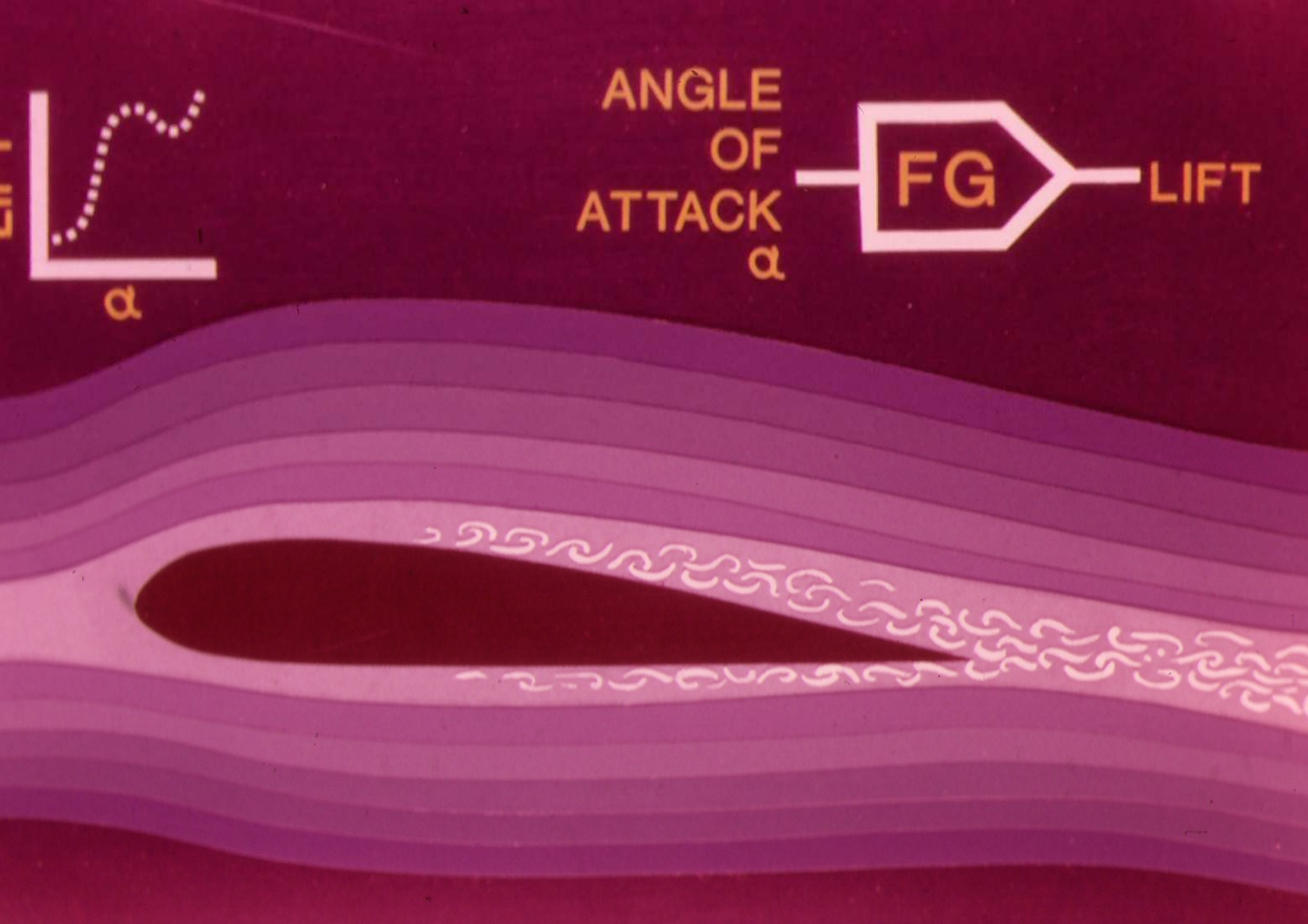


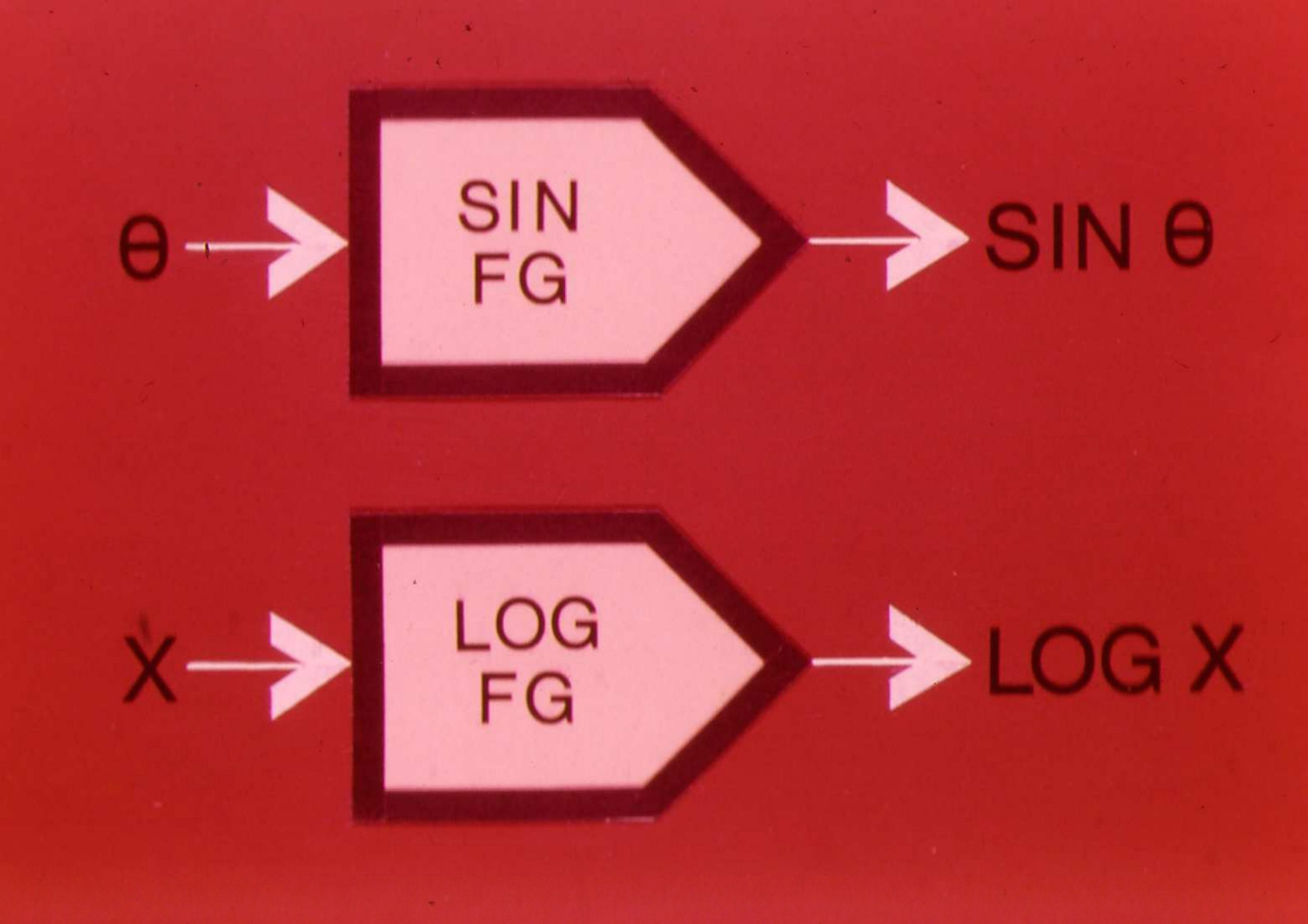
POTENTIOMETERS



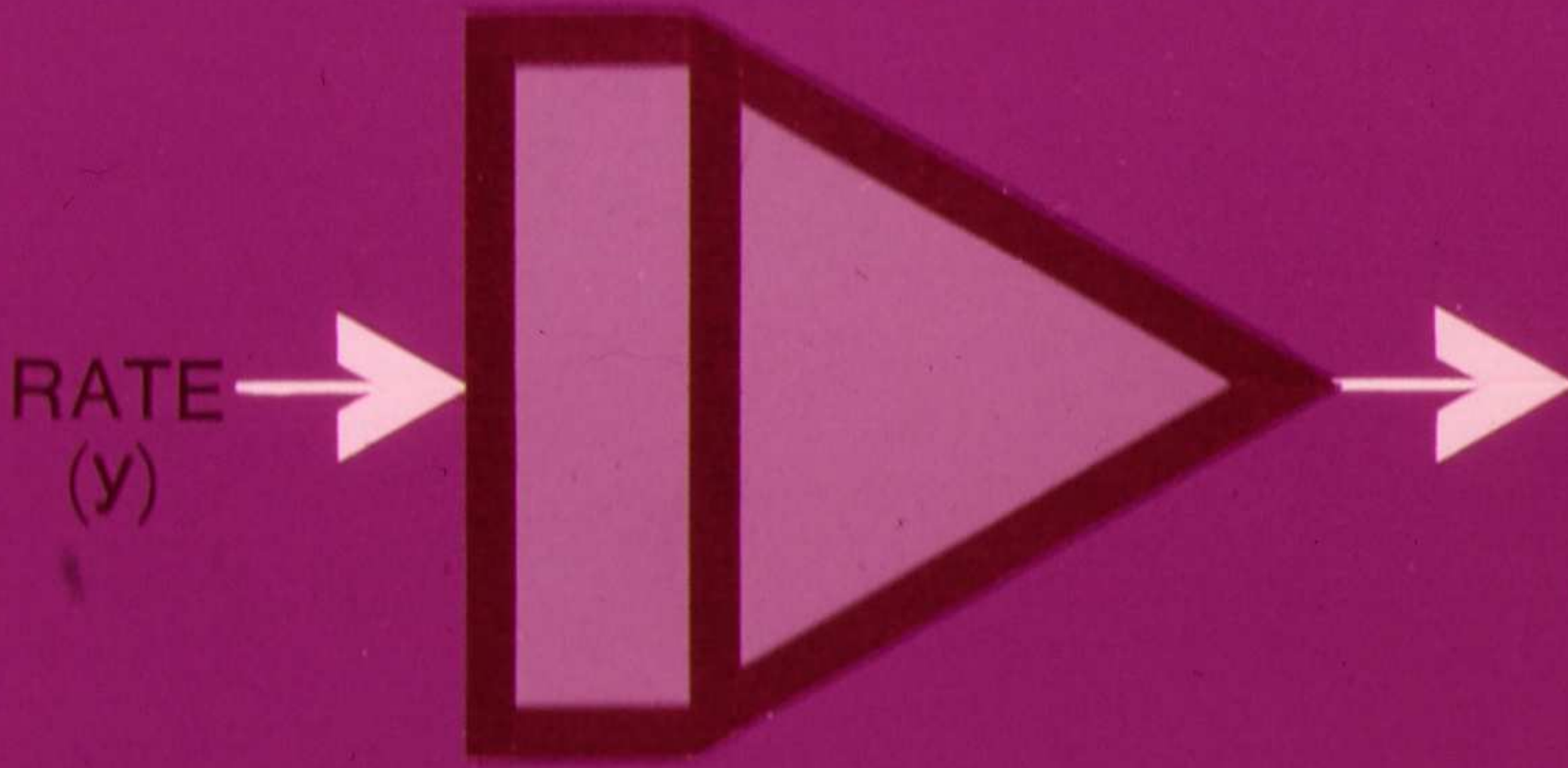

P04

FUNCTION GENERATORS


ANGLE
OF
ATTACK
α
FG
LIFT
α


θ
SIN
FG
SIN θ
X
LOG
FG
LOG X

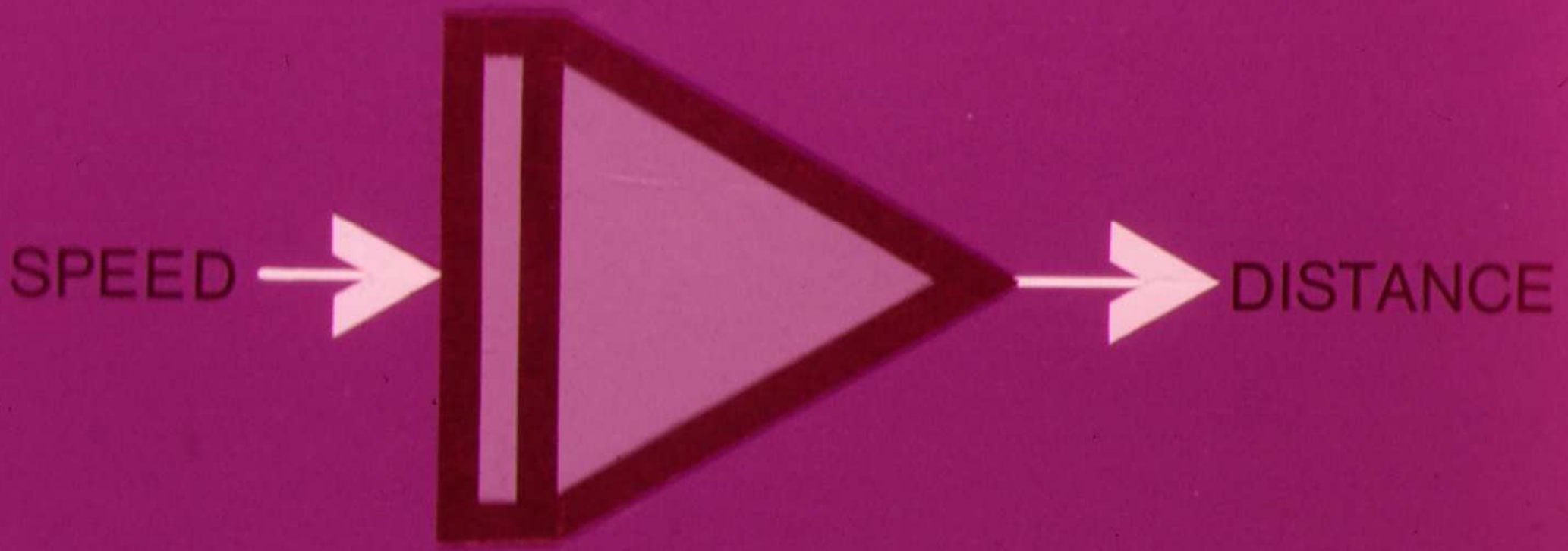
INTEGRATORS

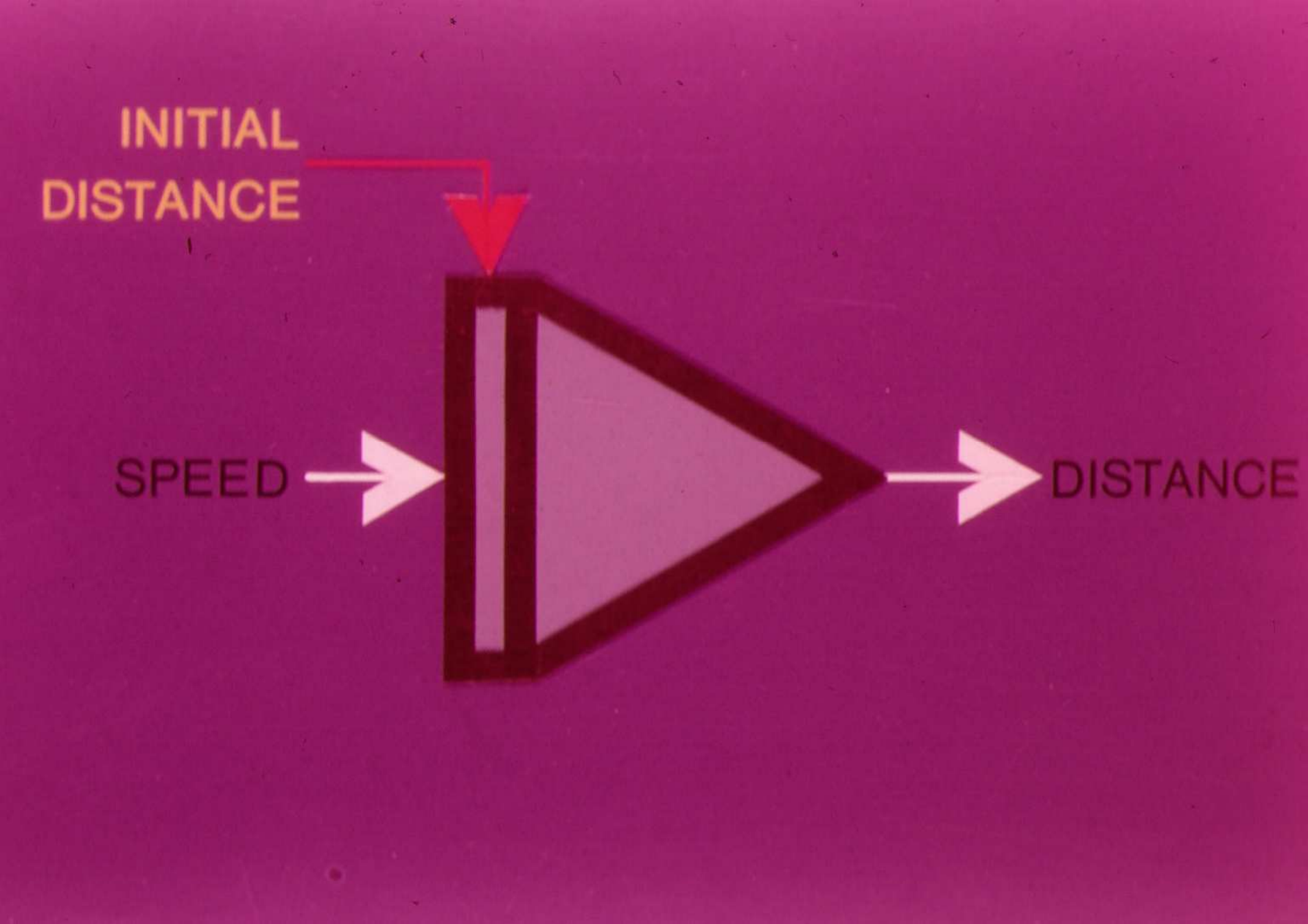


FLOW RATE

HEIGHT = { Integration of Flow Rate + Initial Height


23867

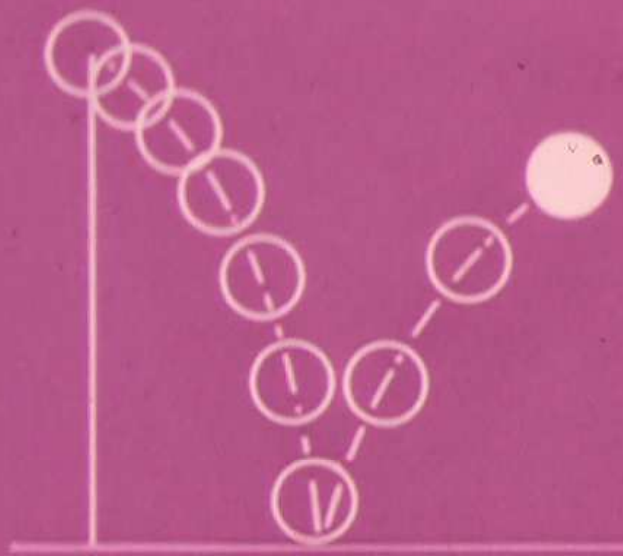

SPEED
DISTANCE


INITIAL
DISTANCE
SPEED
DISTANCE

COMPUTER MODES

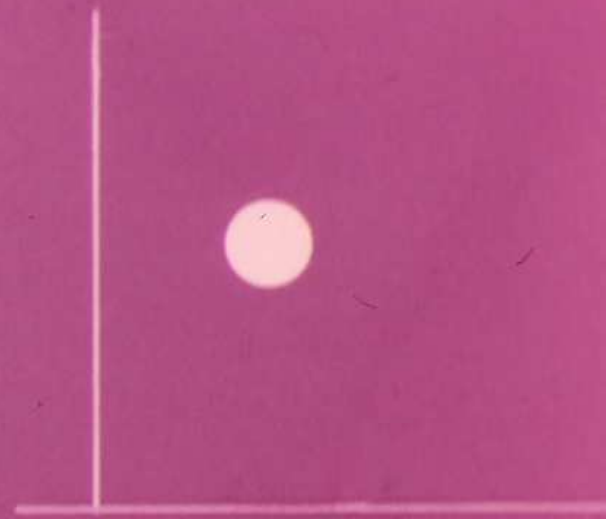
Initial Condition

IC H OP



Operate

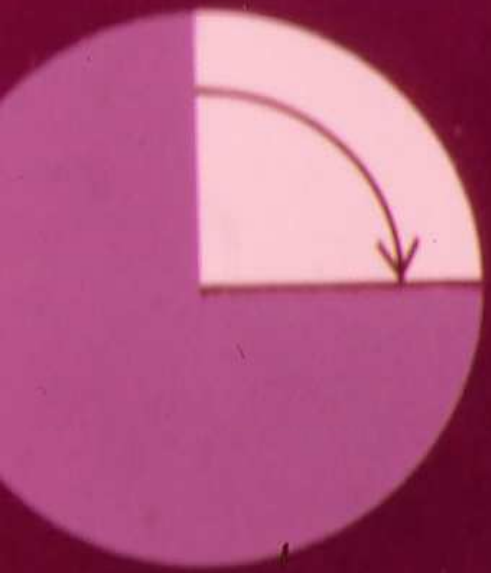
IC H OP



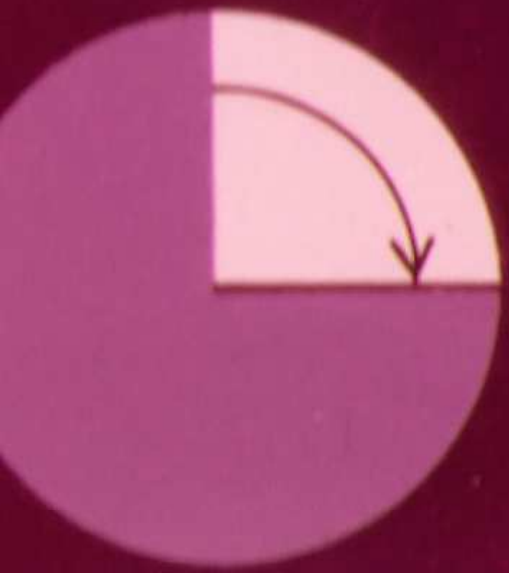
Hold

IC H OP

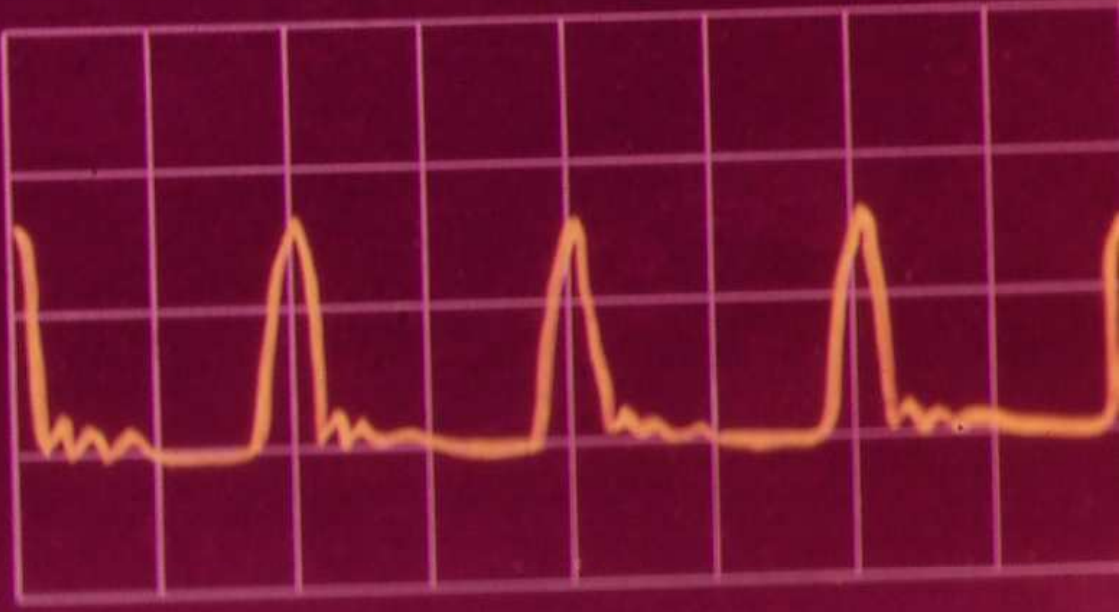
EAL TIME SIMULATION



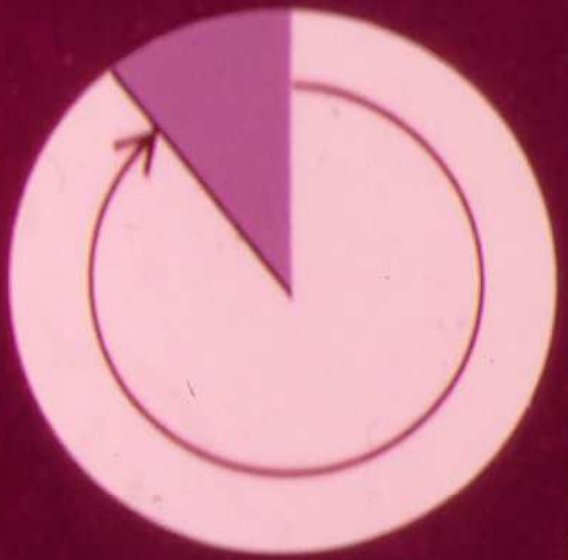
Physical
System



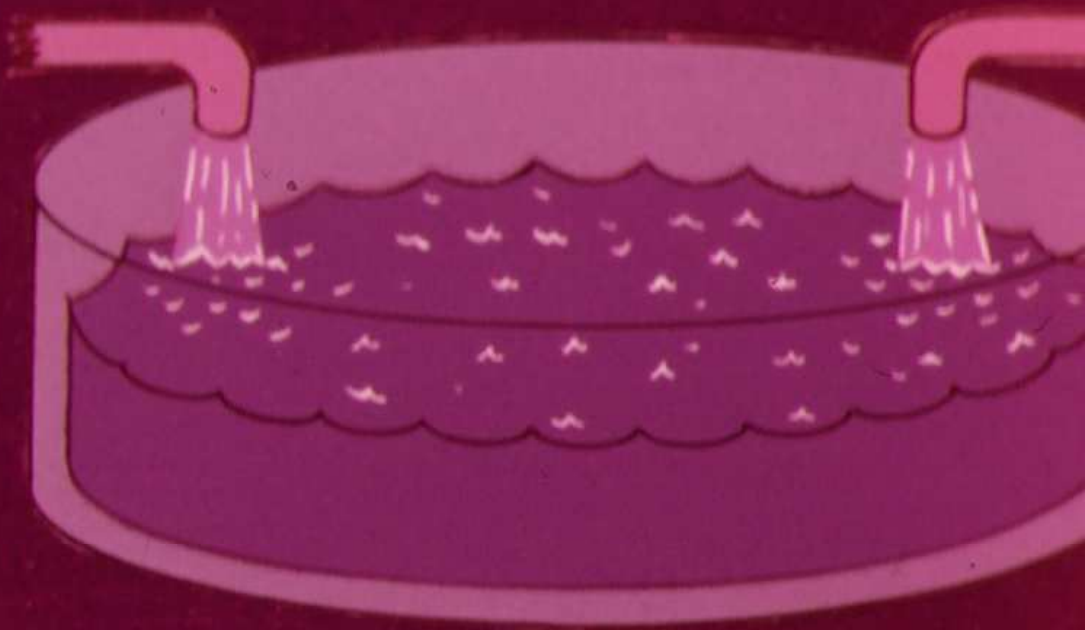
Computer
Simulation

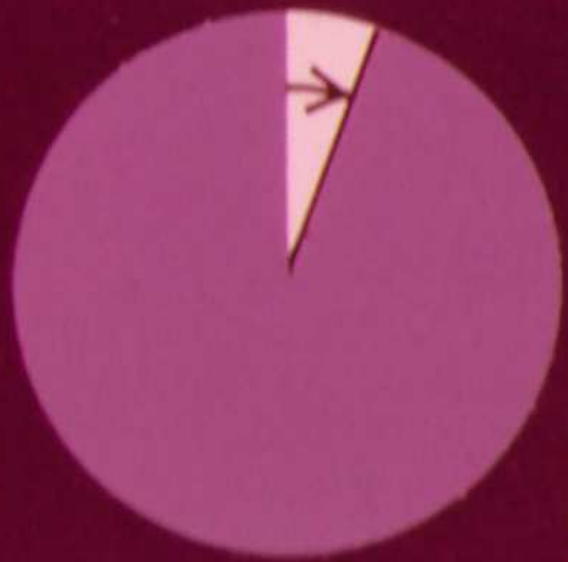


FAST TIME SIMULATION

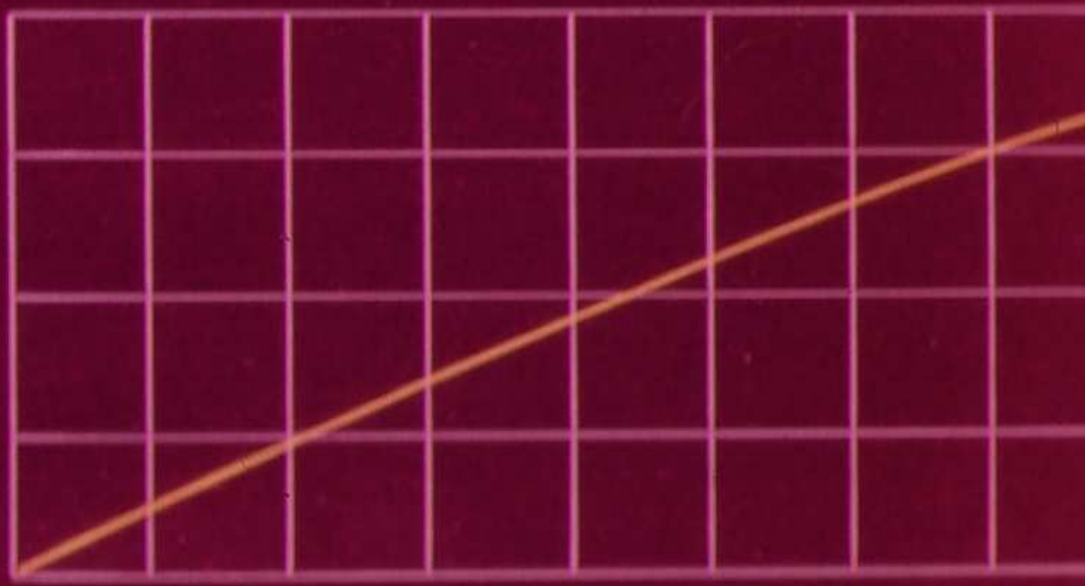


Physical System





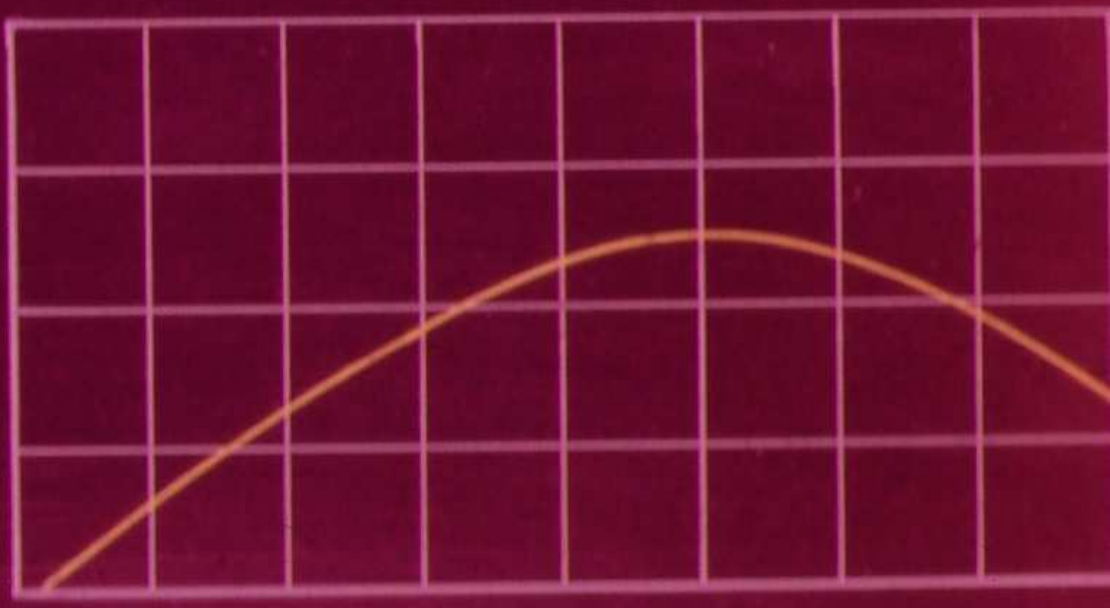
Computer Simulation

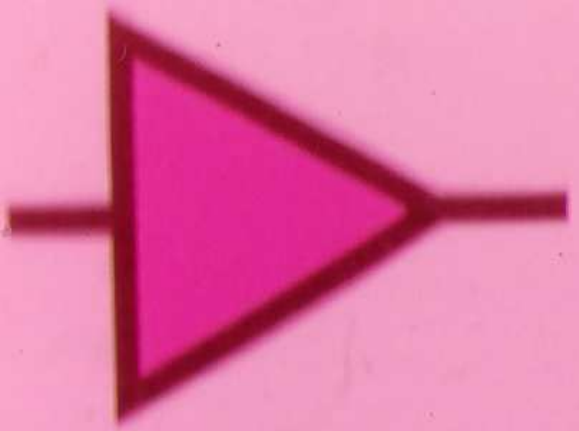


SLOW TIME SIMULATION

Physical System

Computer Simulation



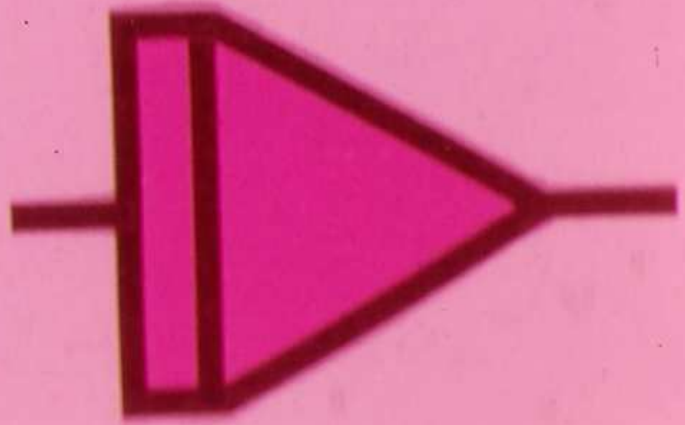


Summers

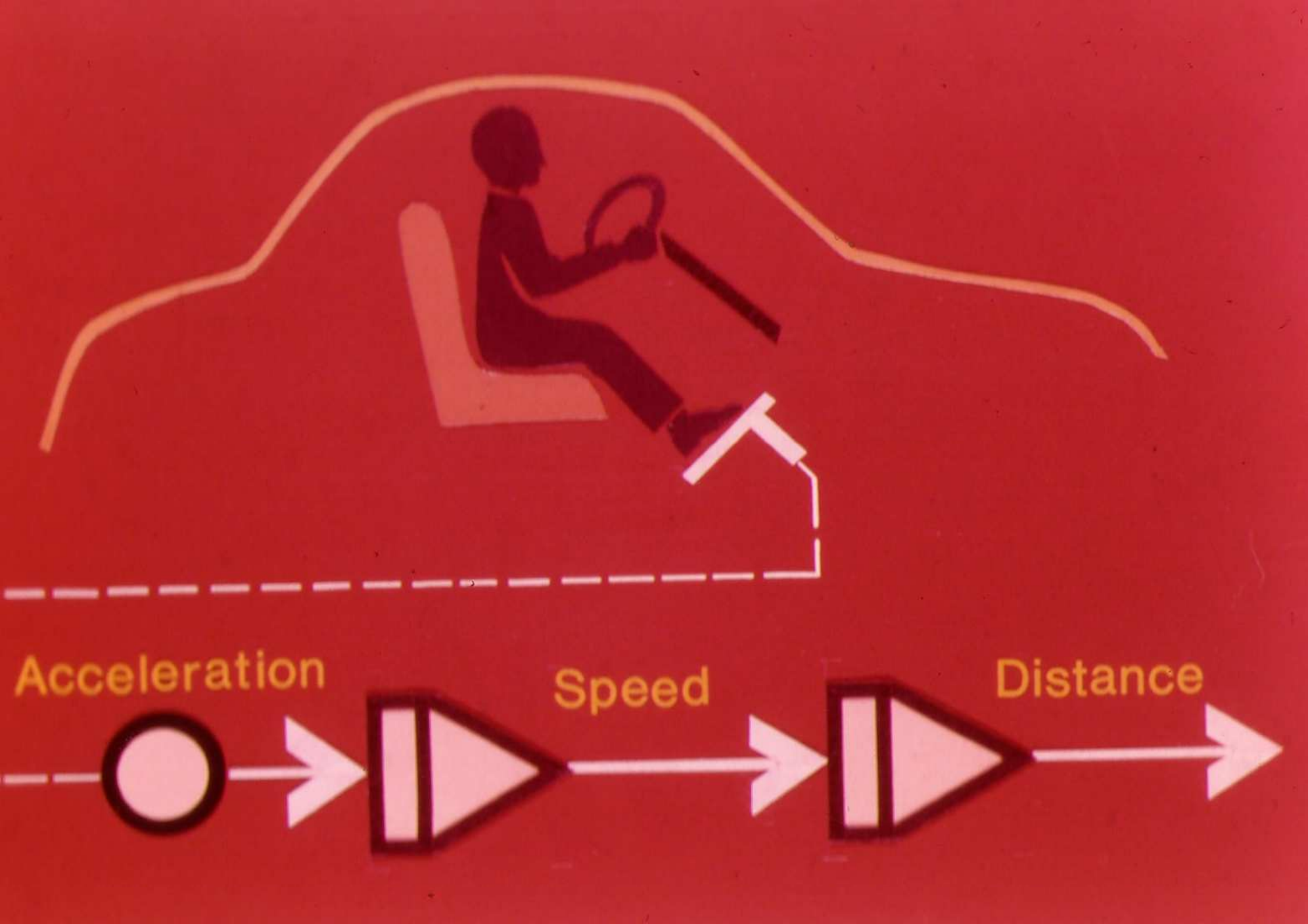
Multipliers

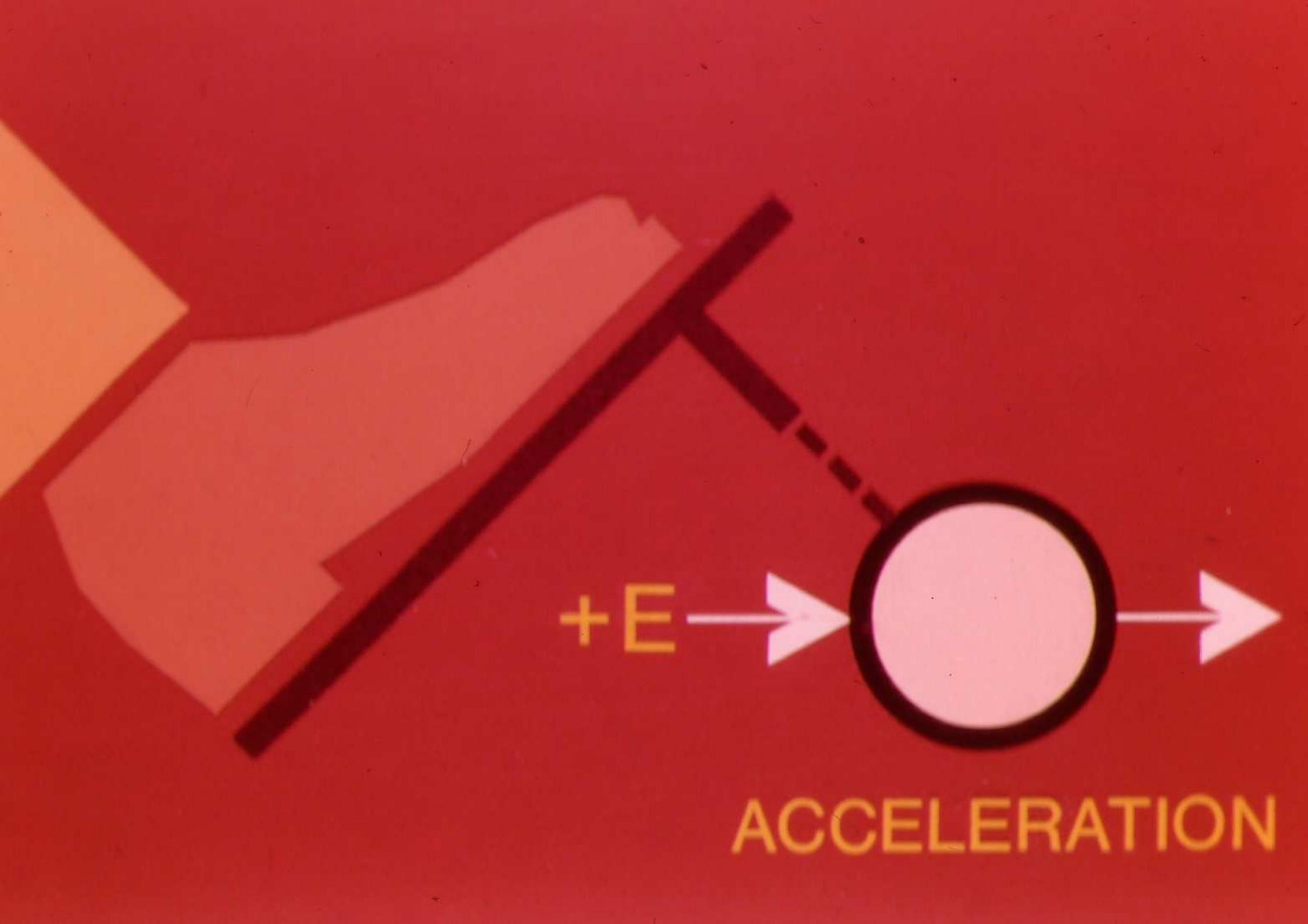
Potentiometers

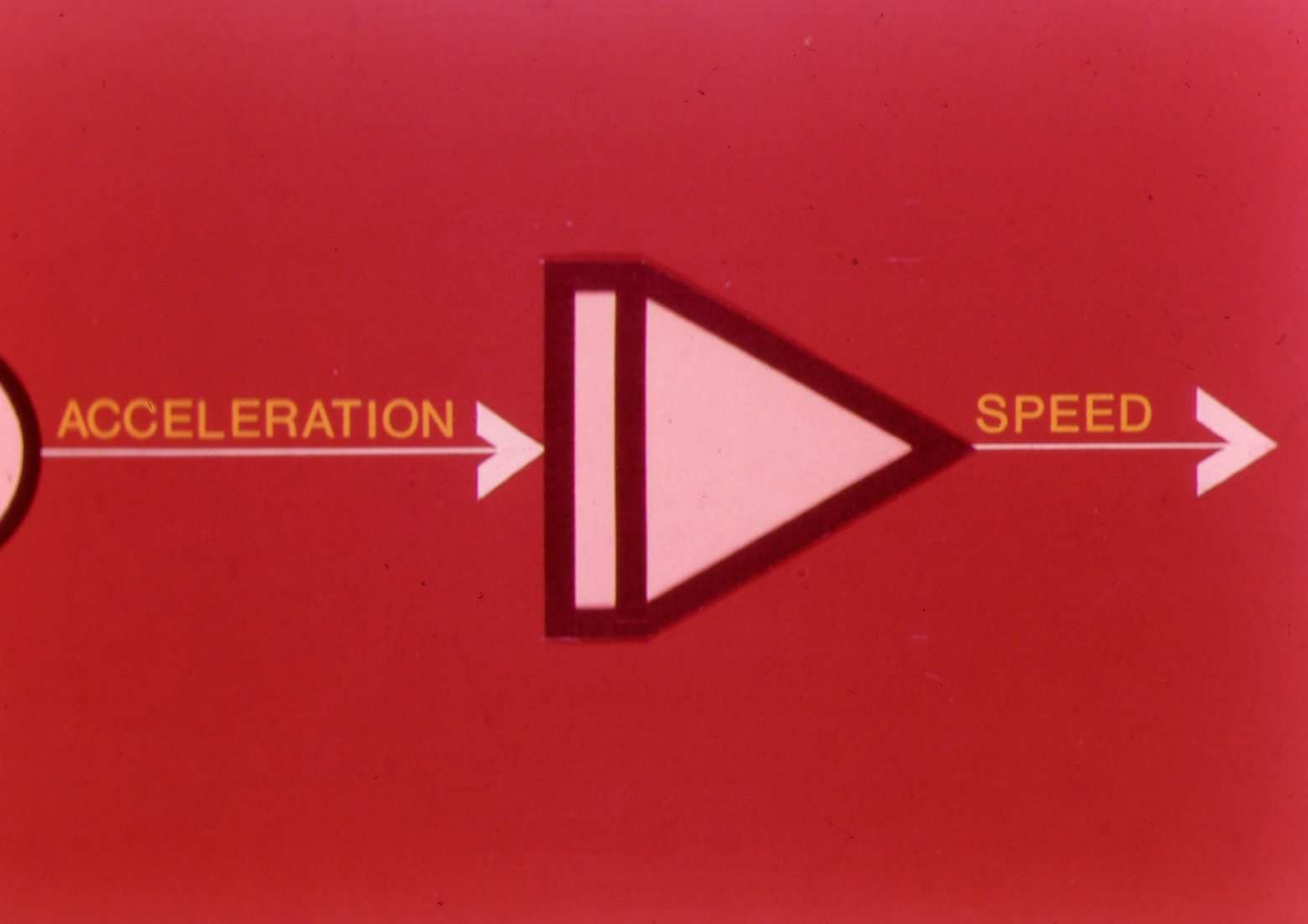
Function Generators

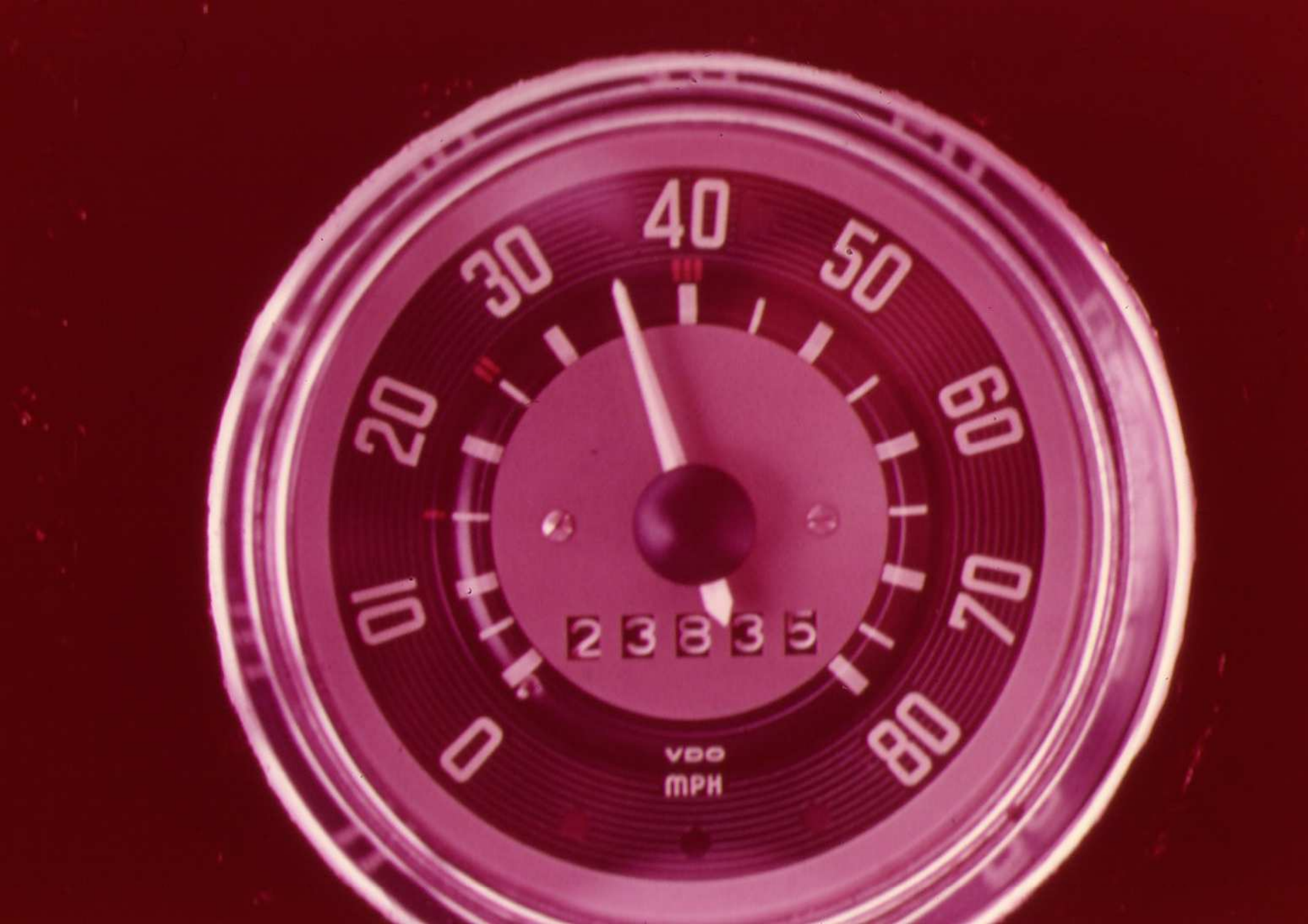


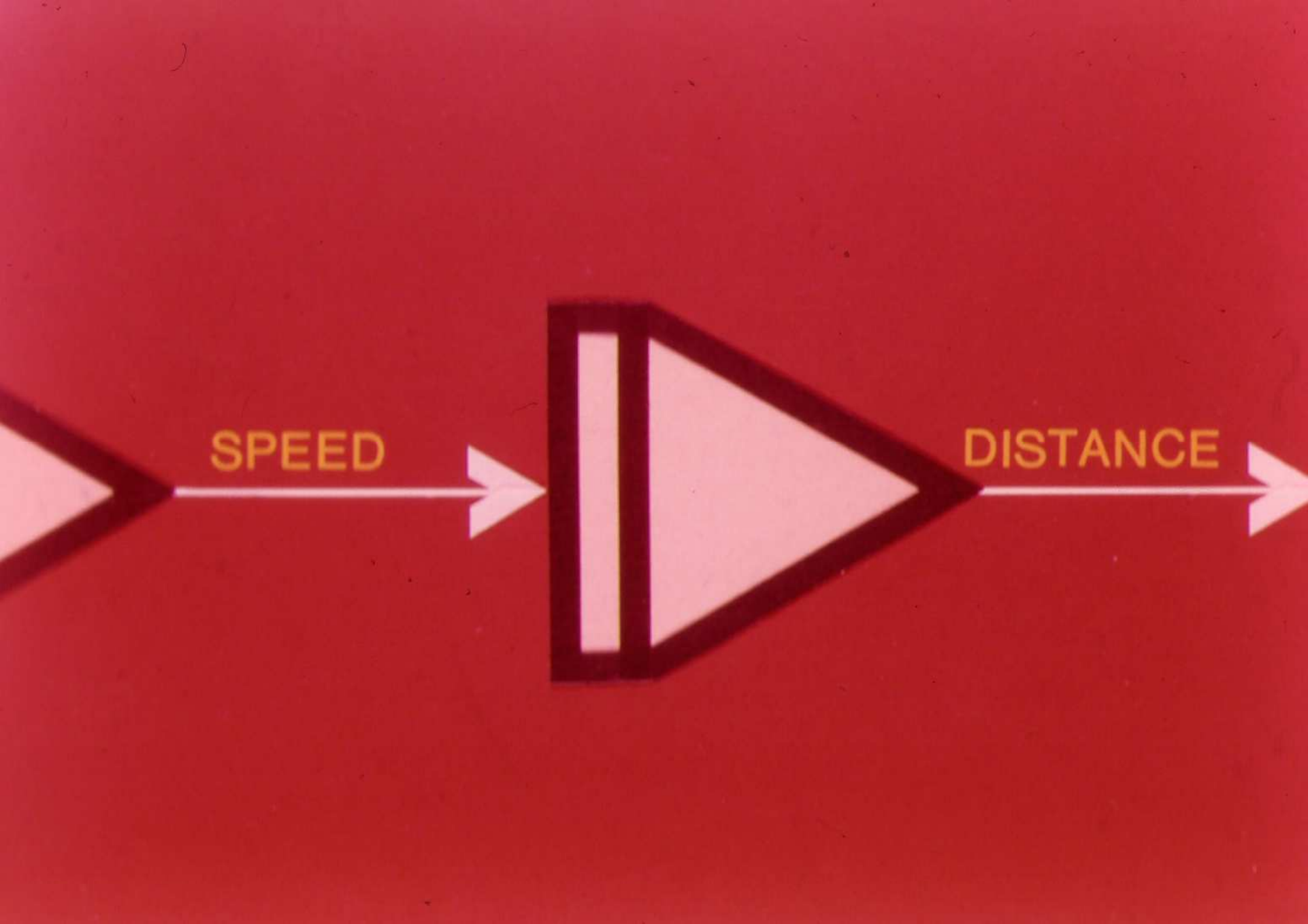
Integrators

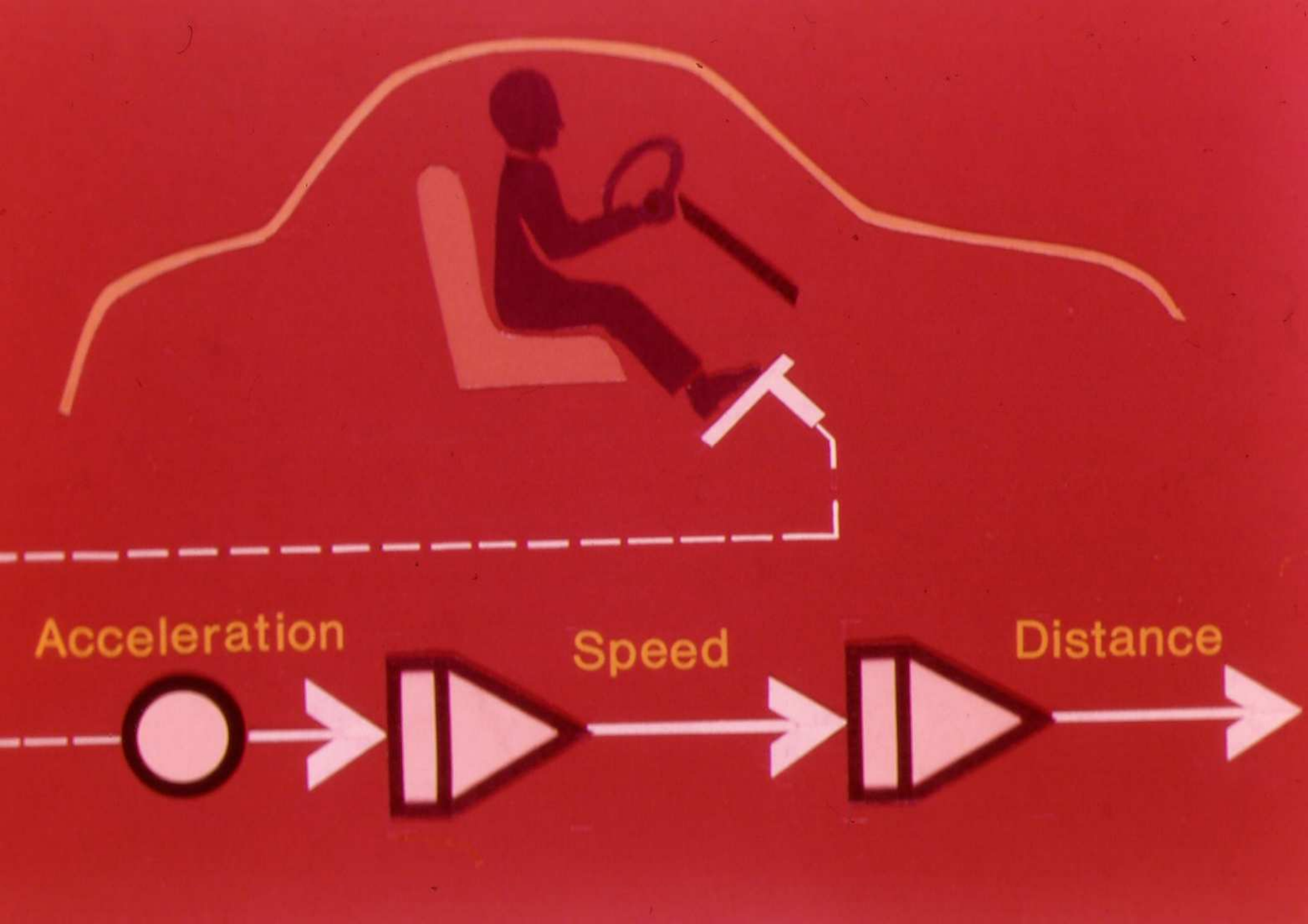

Acceleration
Speed
Distance


+E
ACCELERATION


ACCELERATION
SPEED

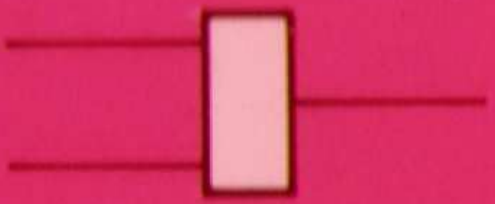

0
10
20
30
40
50
60
70
80
23835
VDO
MPH


SPEED
DISTANCE


Acceleration
Speed
Distance

ANALOG/HYBRID employs digital logic elements to solve non-linear problems

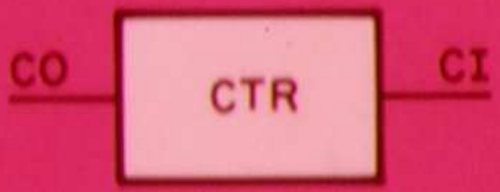
COMPARATOR



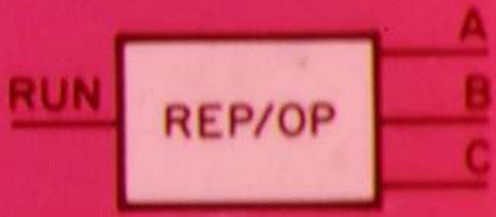
OR GATE

AND GATE

FLIP-FLOP

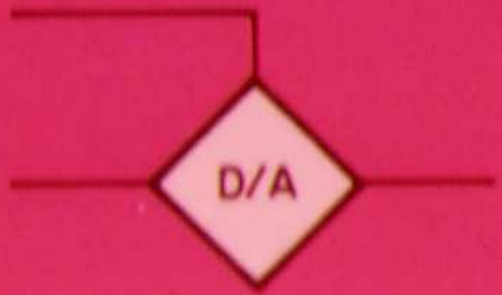


COUNTER



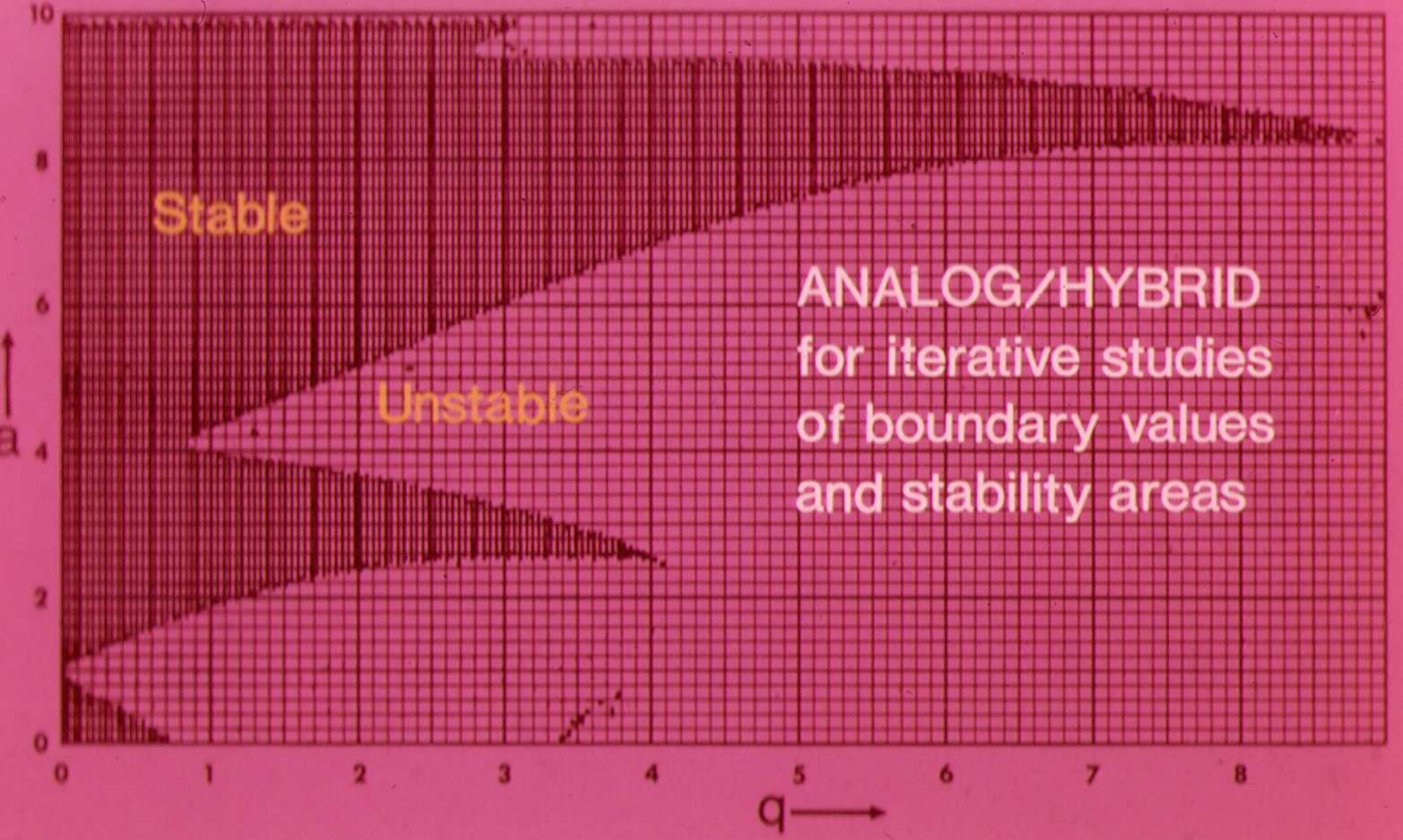
TIMER

MONOSTABLE



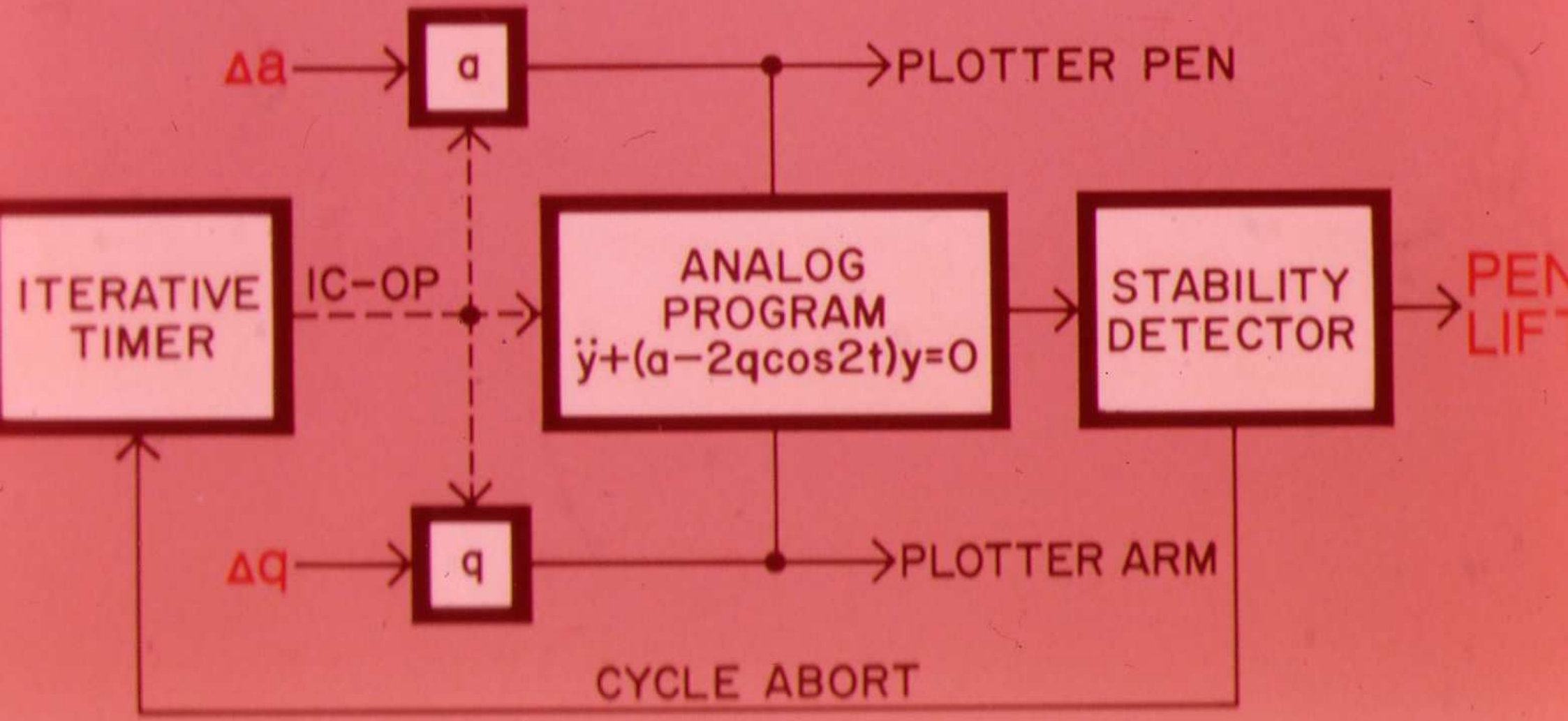
SWITCH

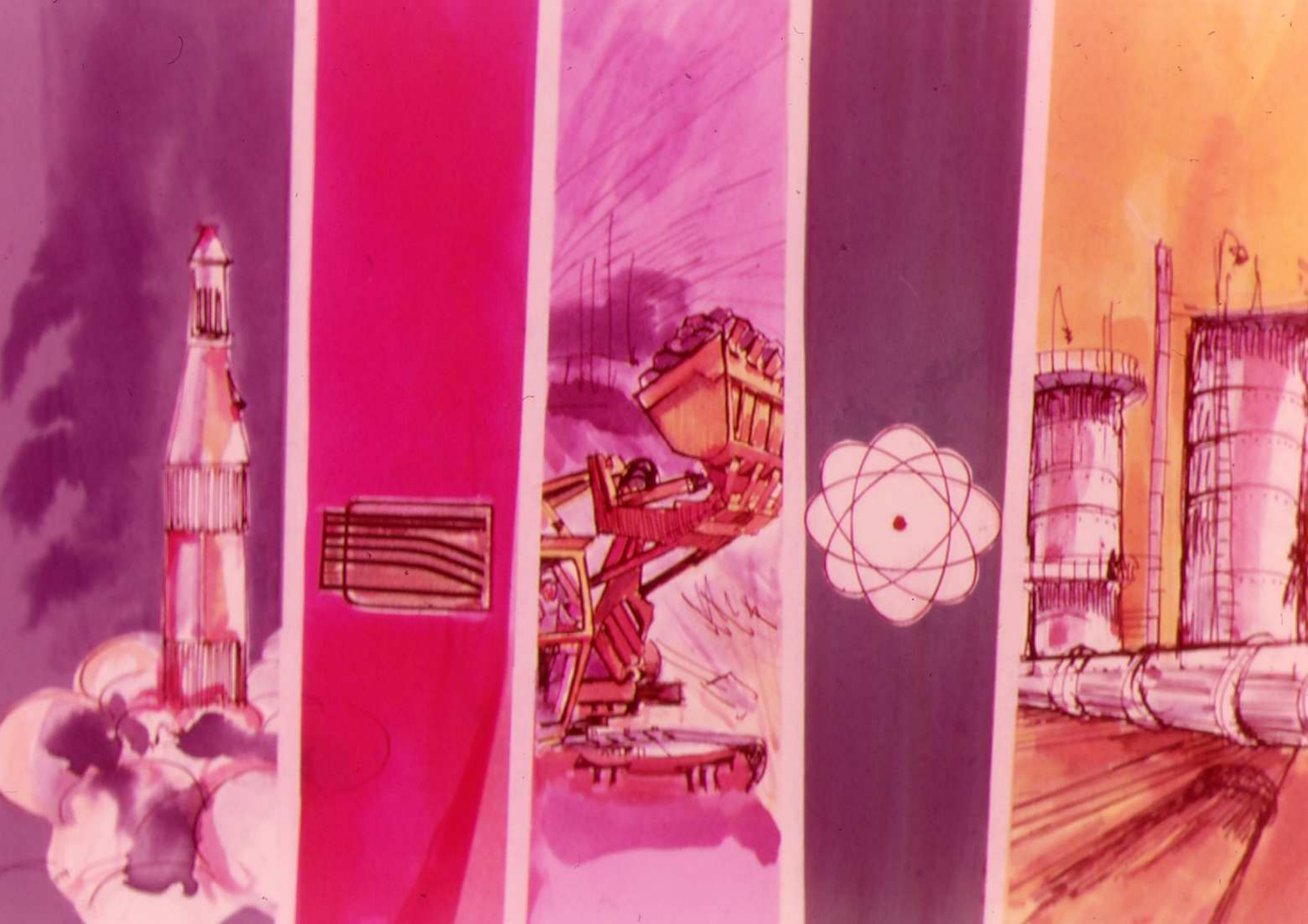
TRACK/STOR

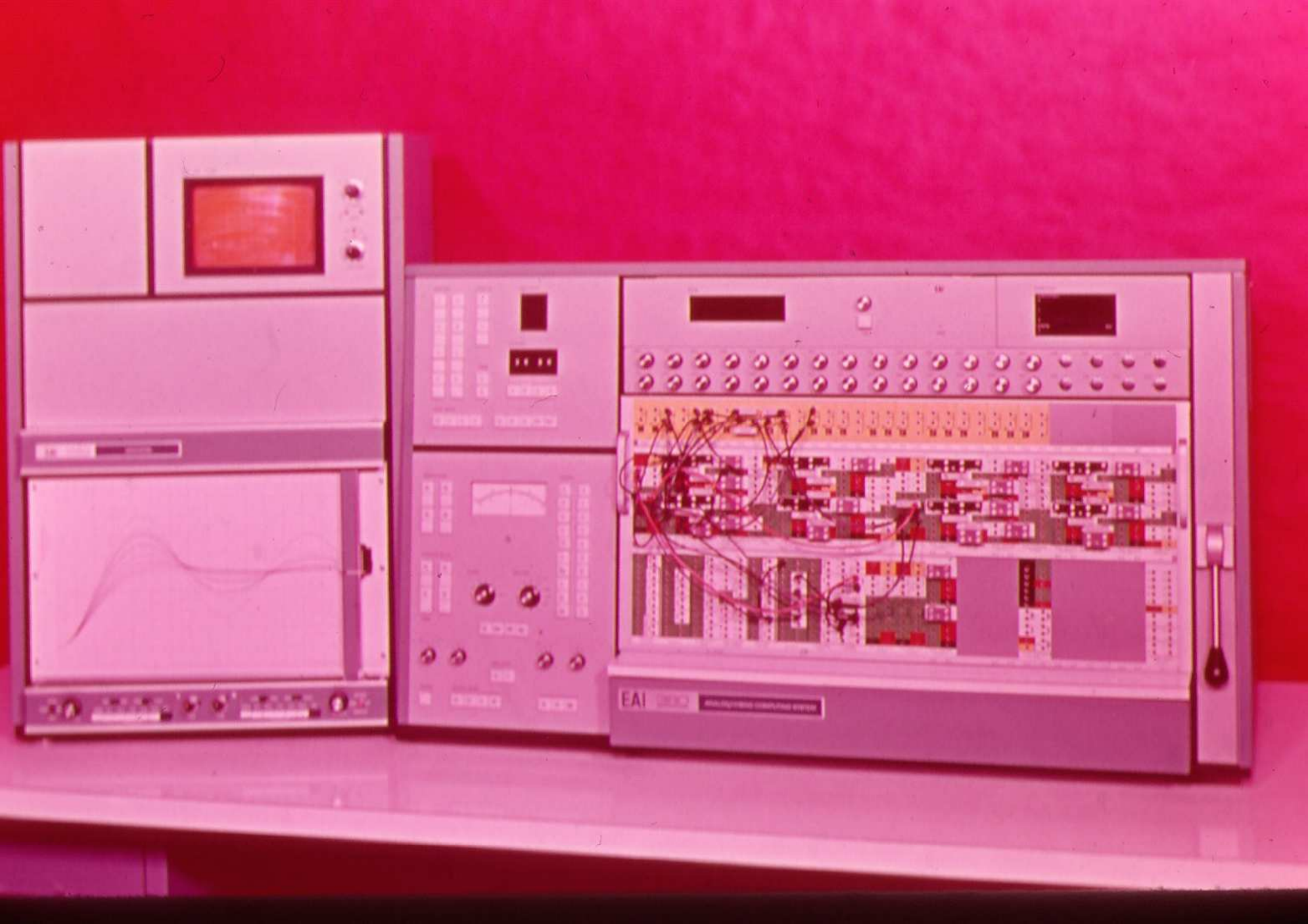


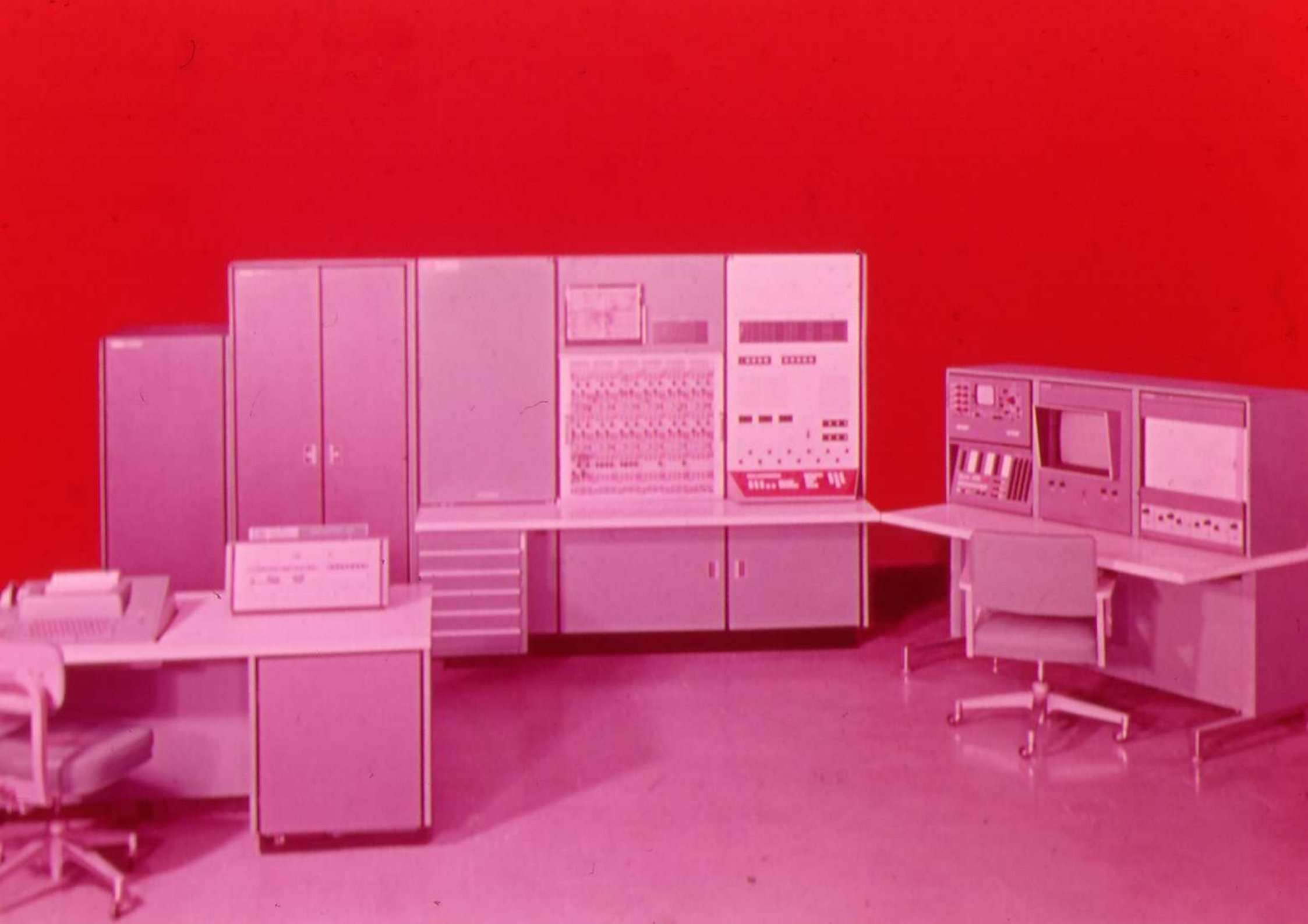
Stability plot for Mathieu's Equation $\ddot{y}+(a-2q\cos 2t)y=0$

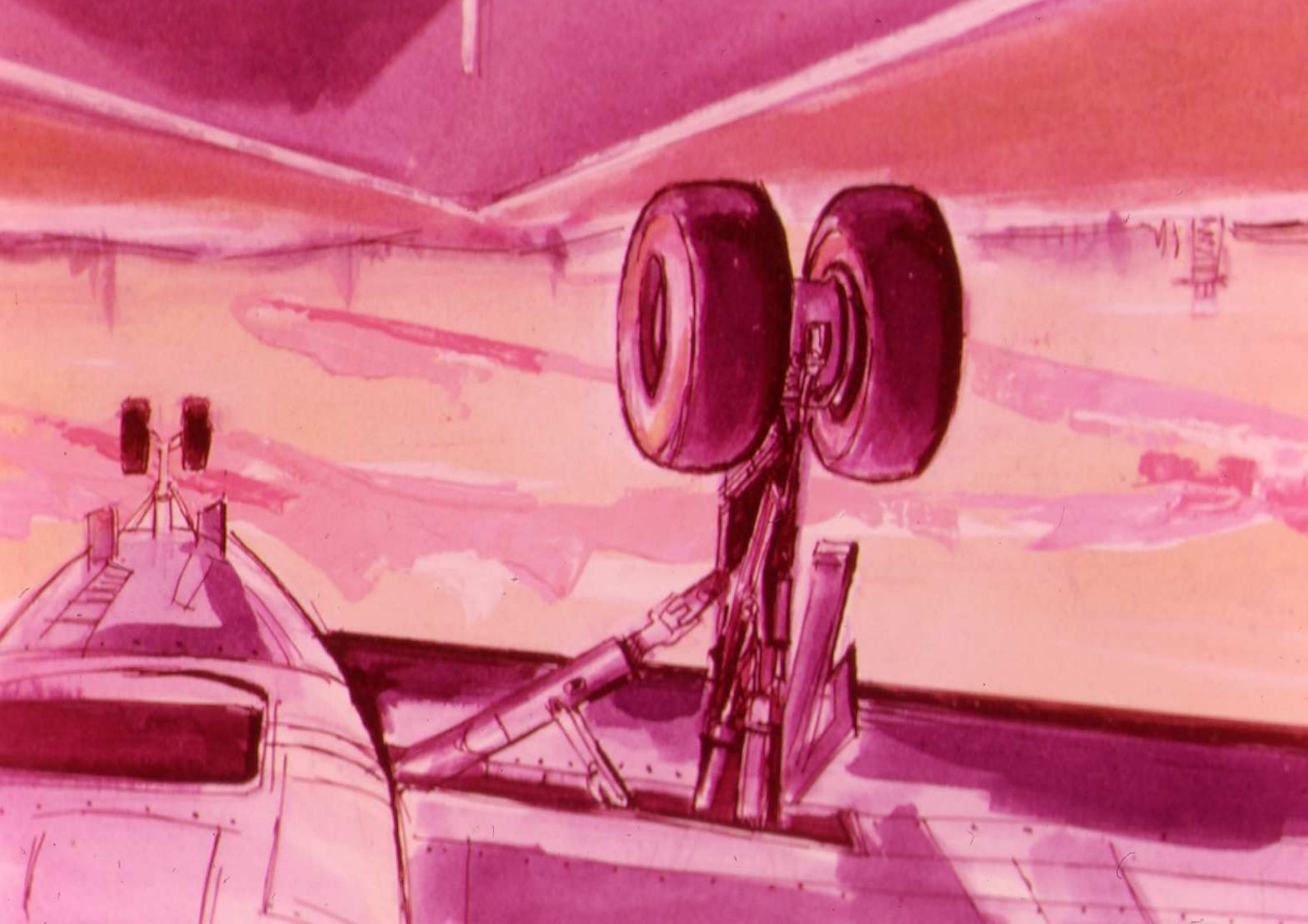
Functional Diagram for program of MATHIEU'S EQUATION



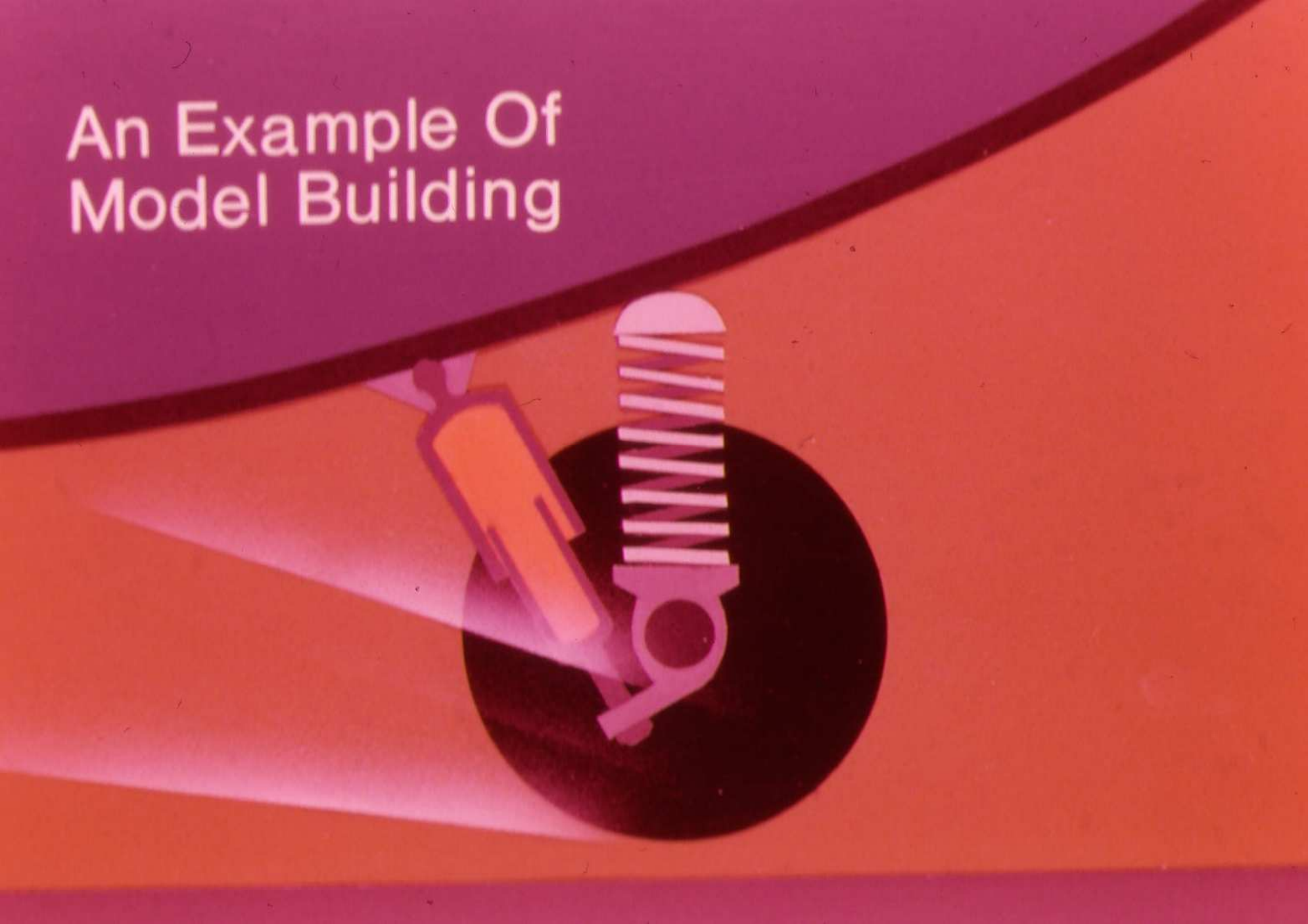



EAI

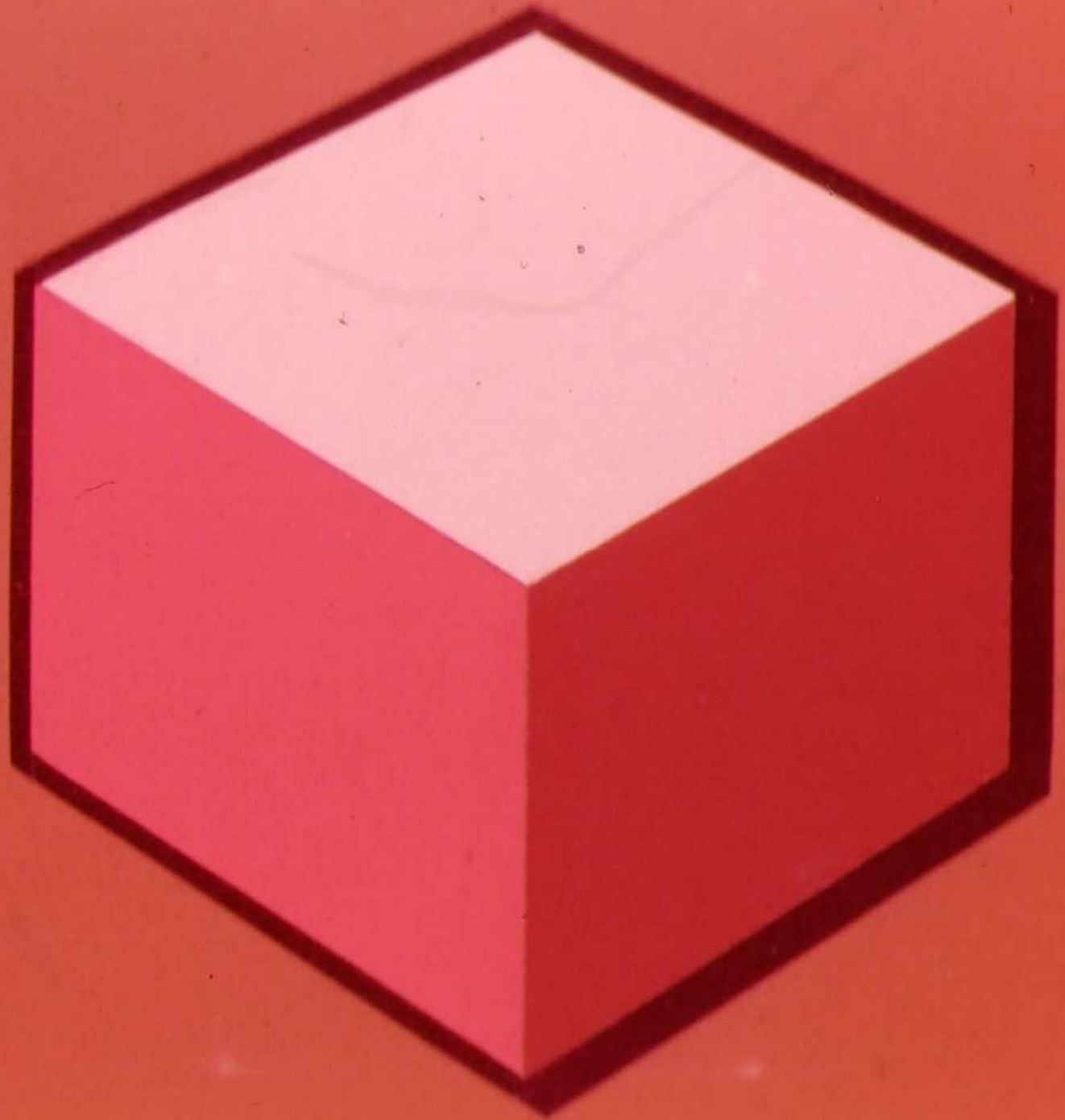




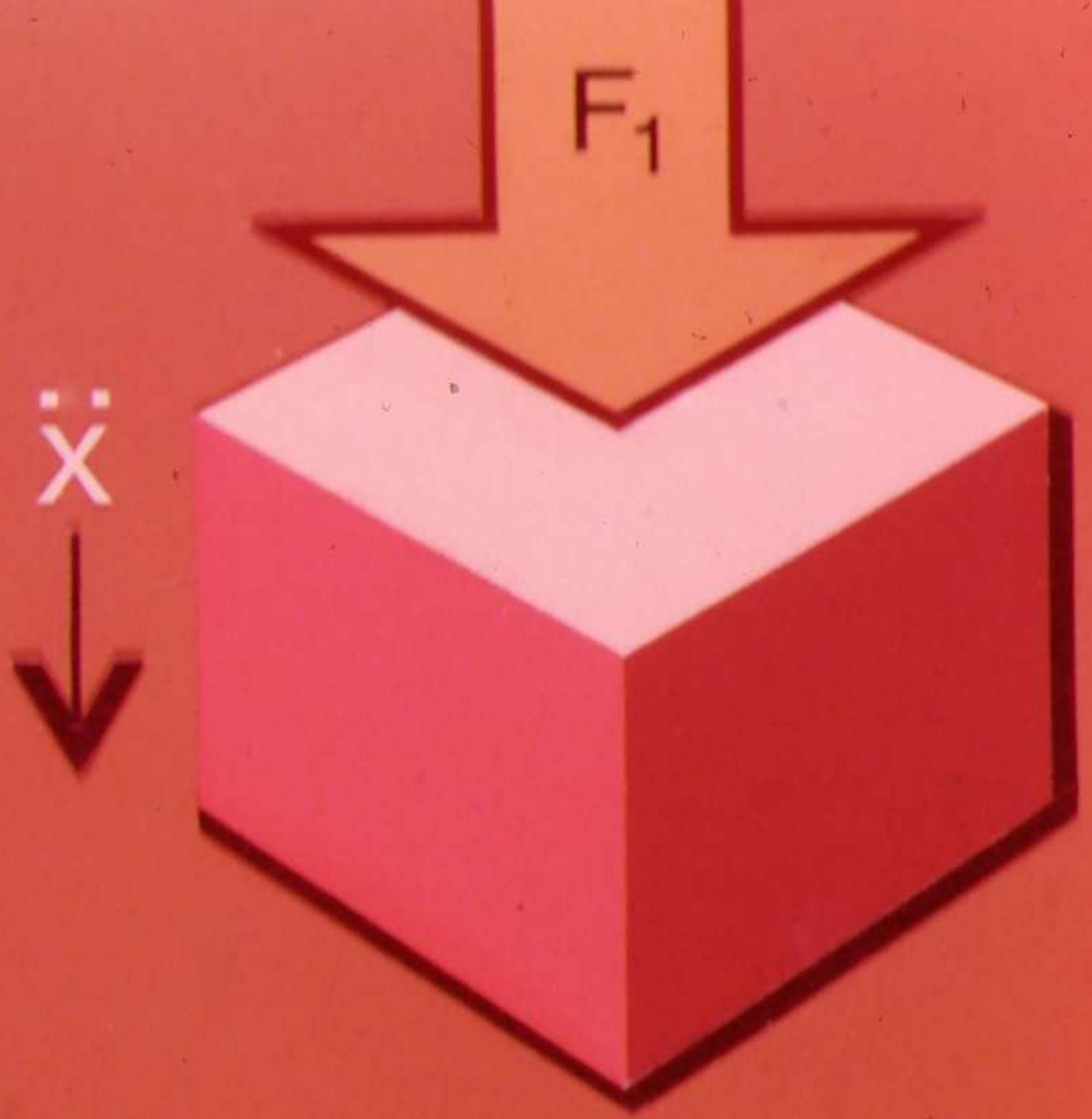
An Example Of Model Building



MASS



$F_1 = M\ddot{x}$



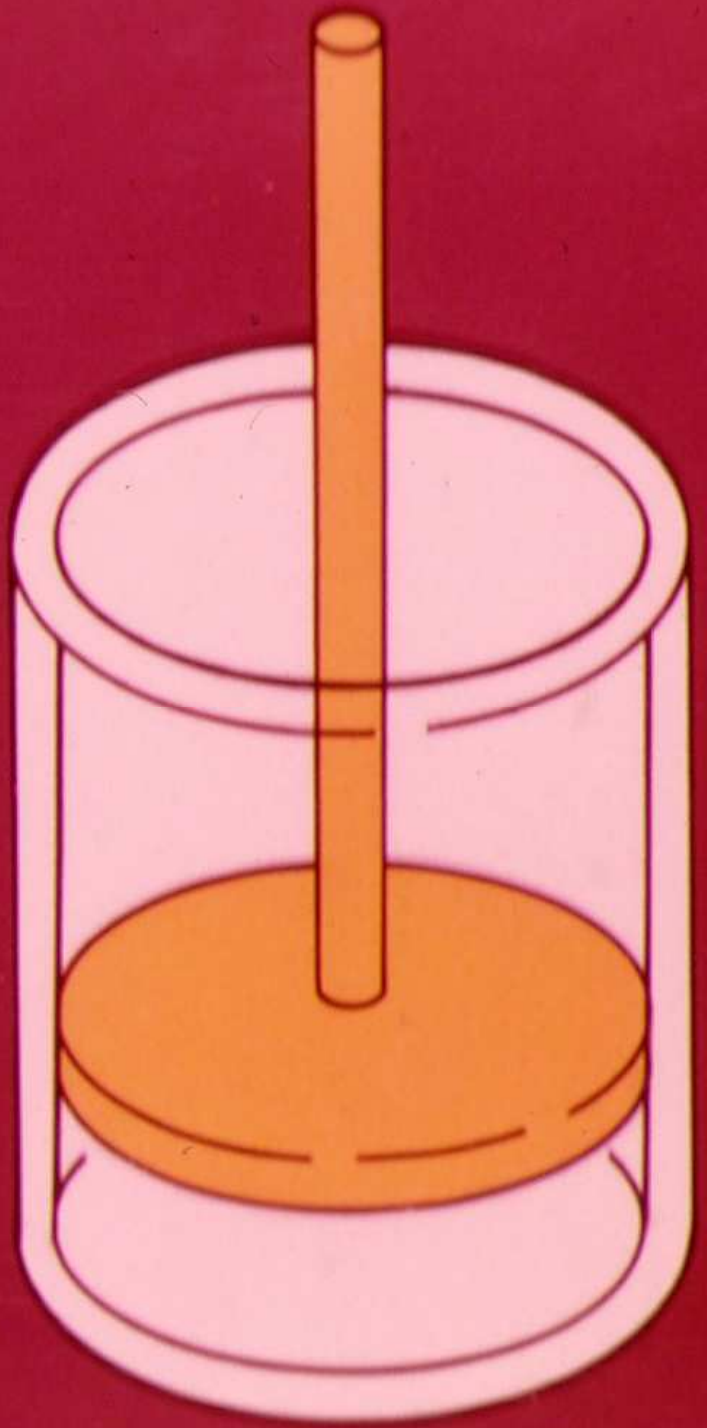
FORCE = Mass x Acceleration

SPRING

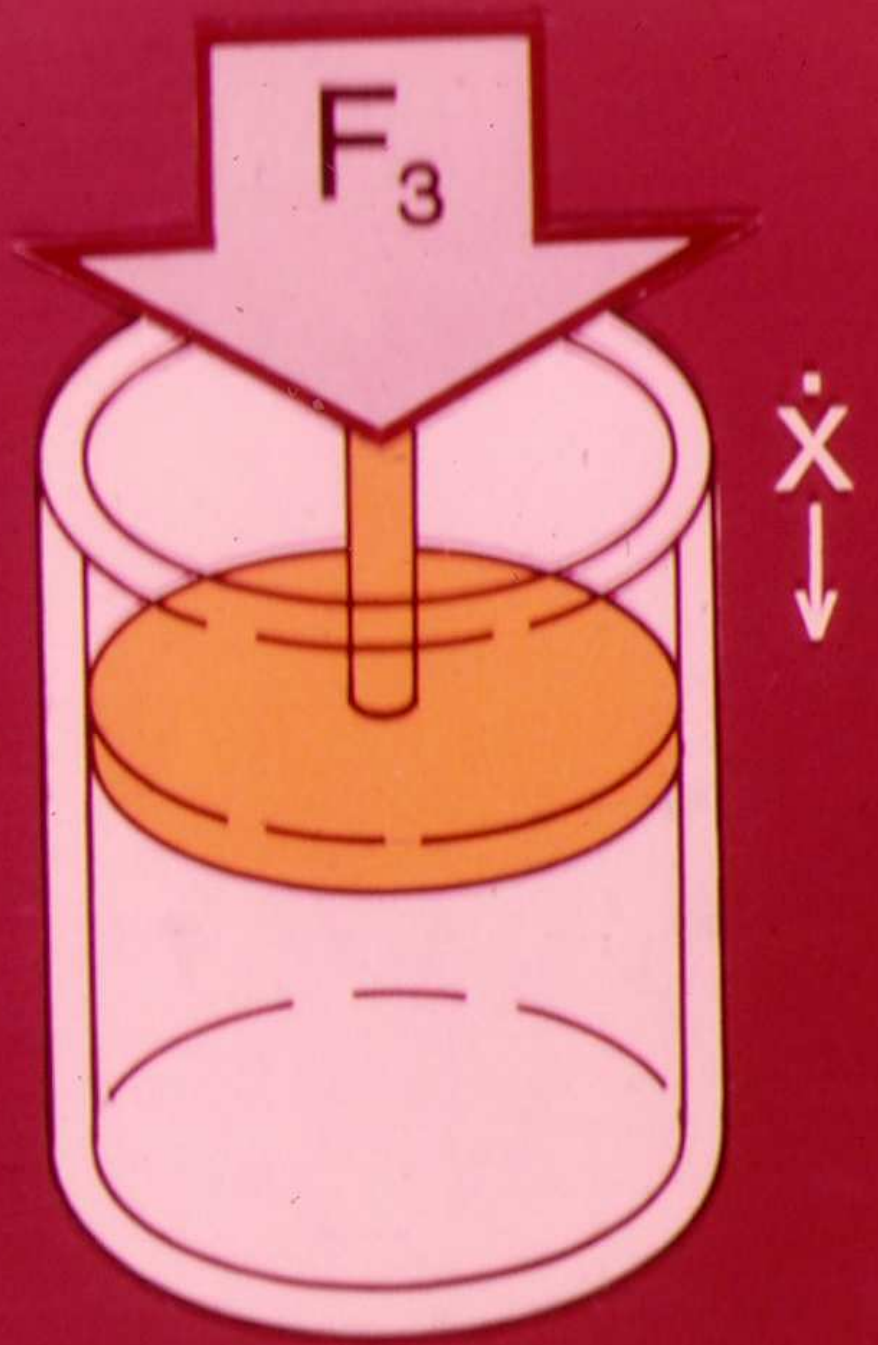
$F_2 = Sx$

FORCE=SPRING CONSTANT x DISPLACEMENT

DAMPER

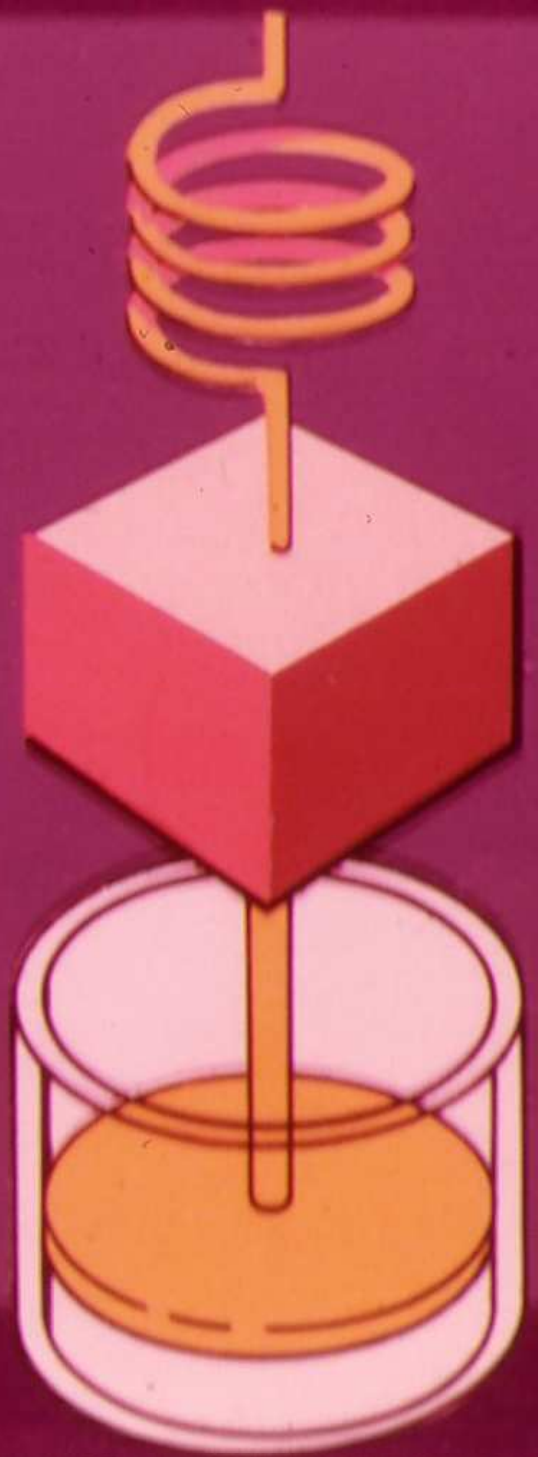


$$F_3 = D\dot{x}$$



FORCE = Damping Factor x Velocity

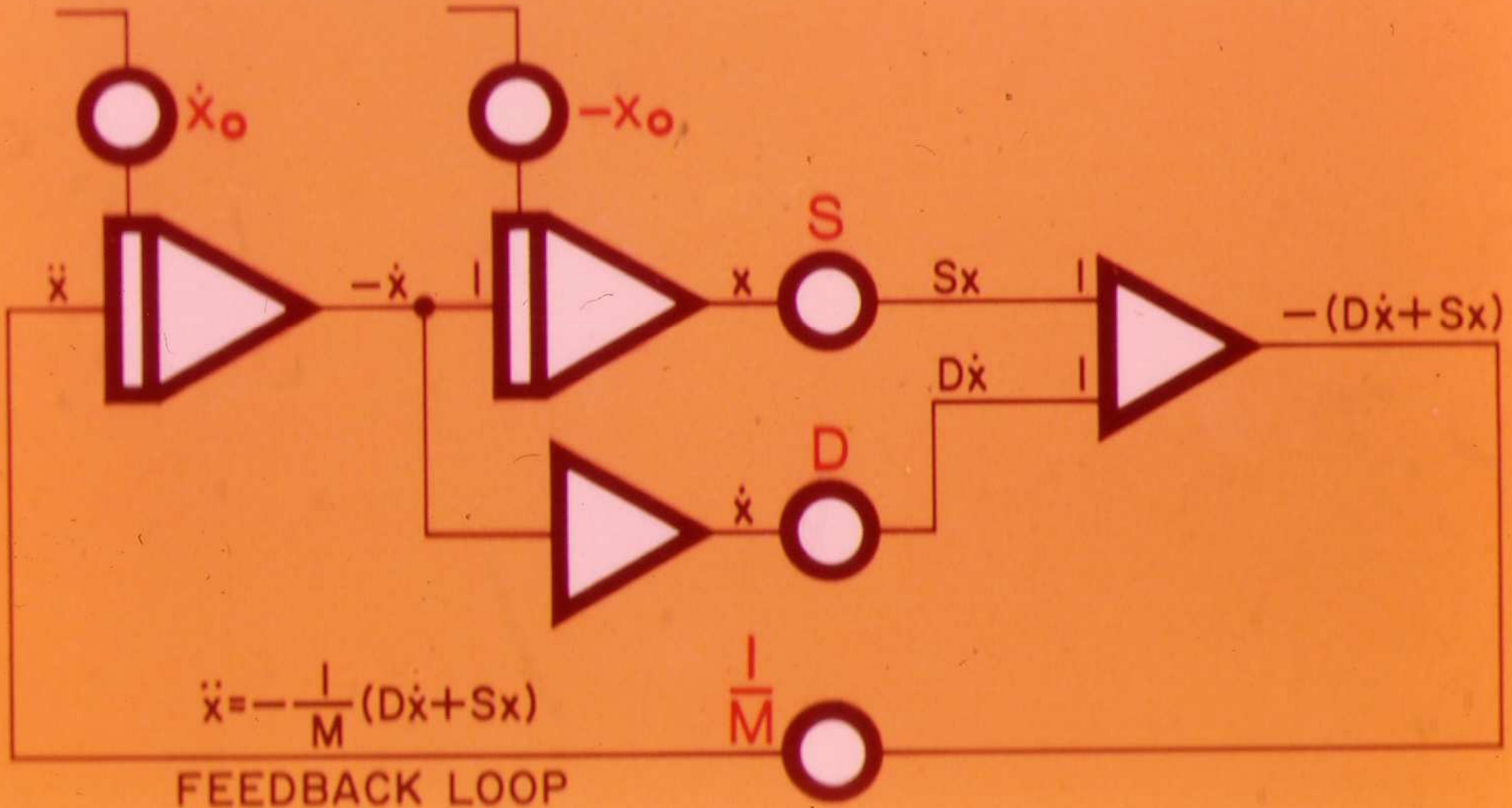
$$F_1+F_2+F_3=0$$

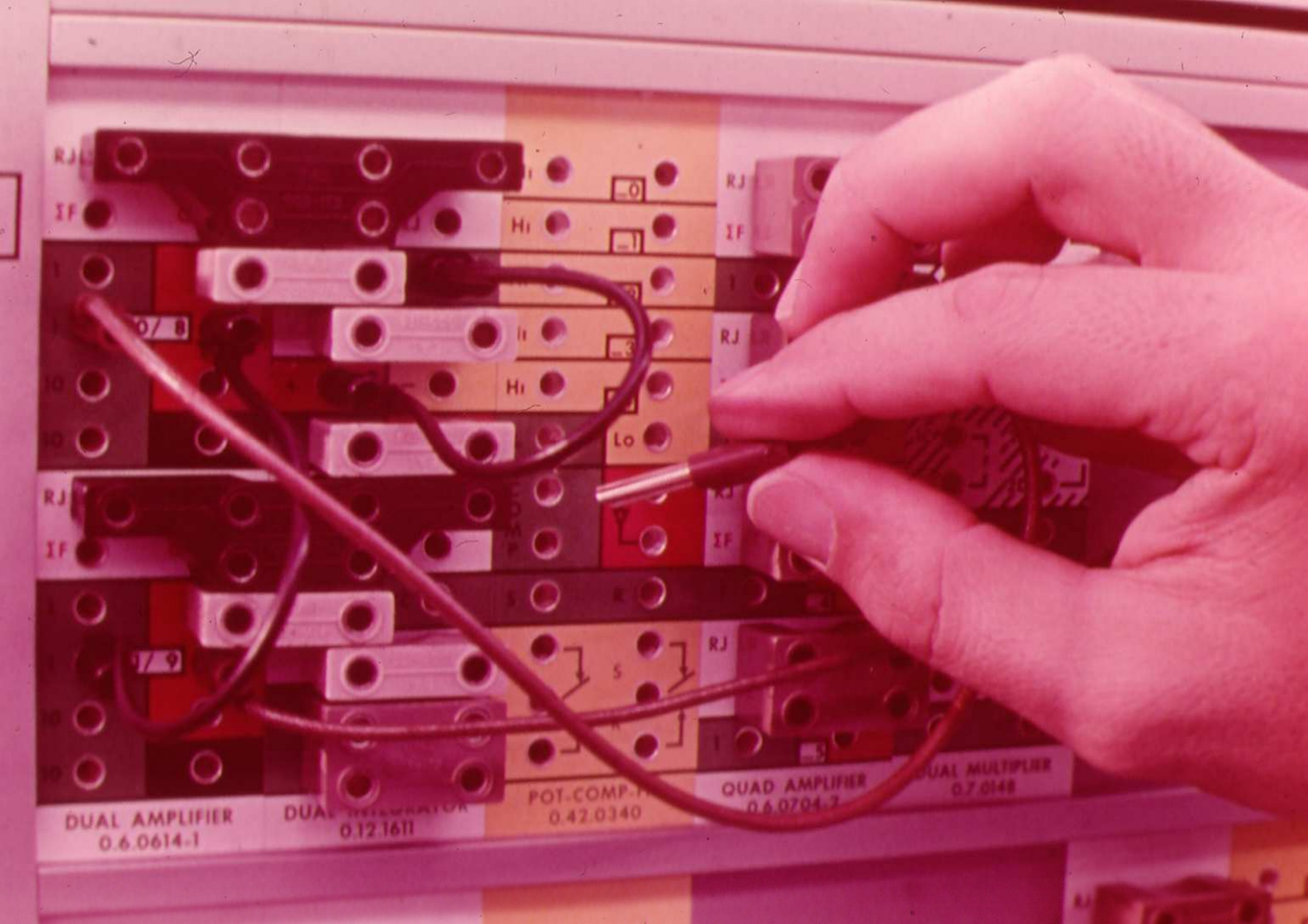


$$M\ddot{x} + D\dot{x} + Sx = 0$$

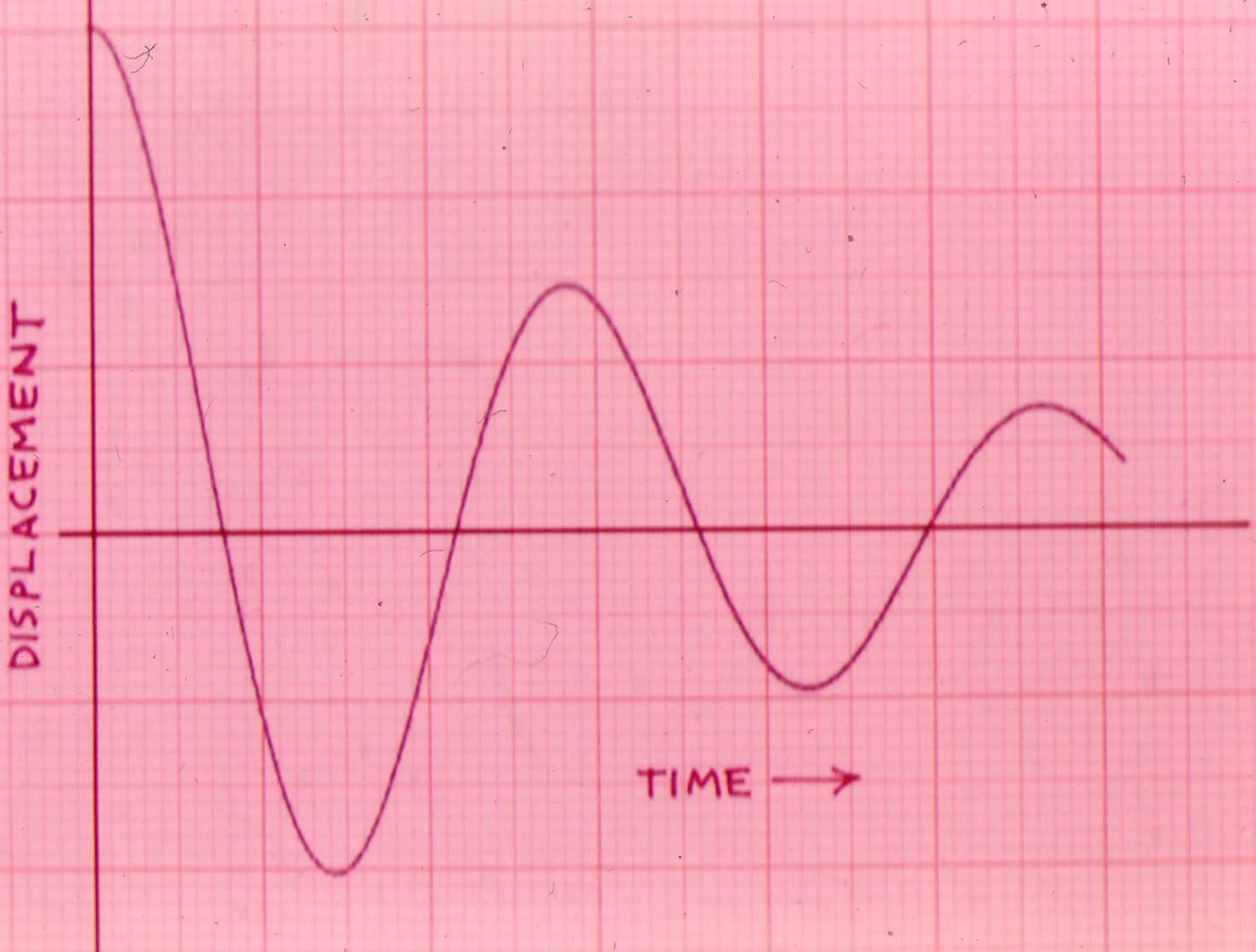
$M\ddot{x}+D\dot{x}+Sx=0$

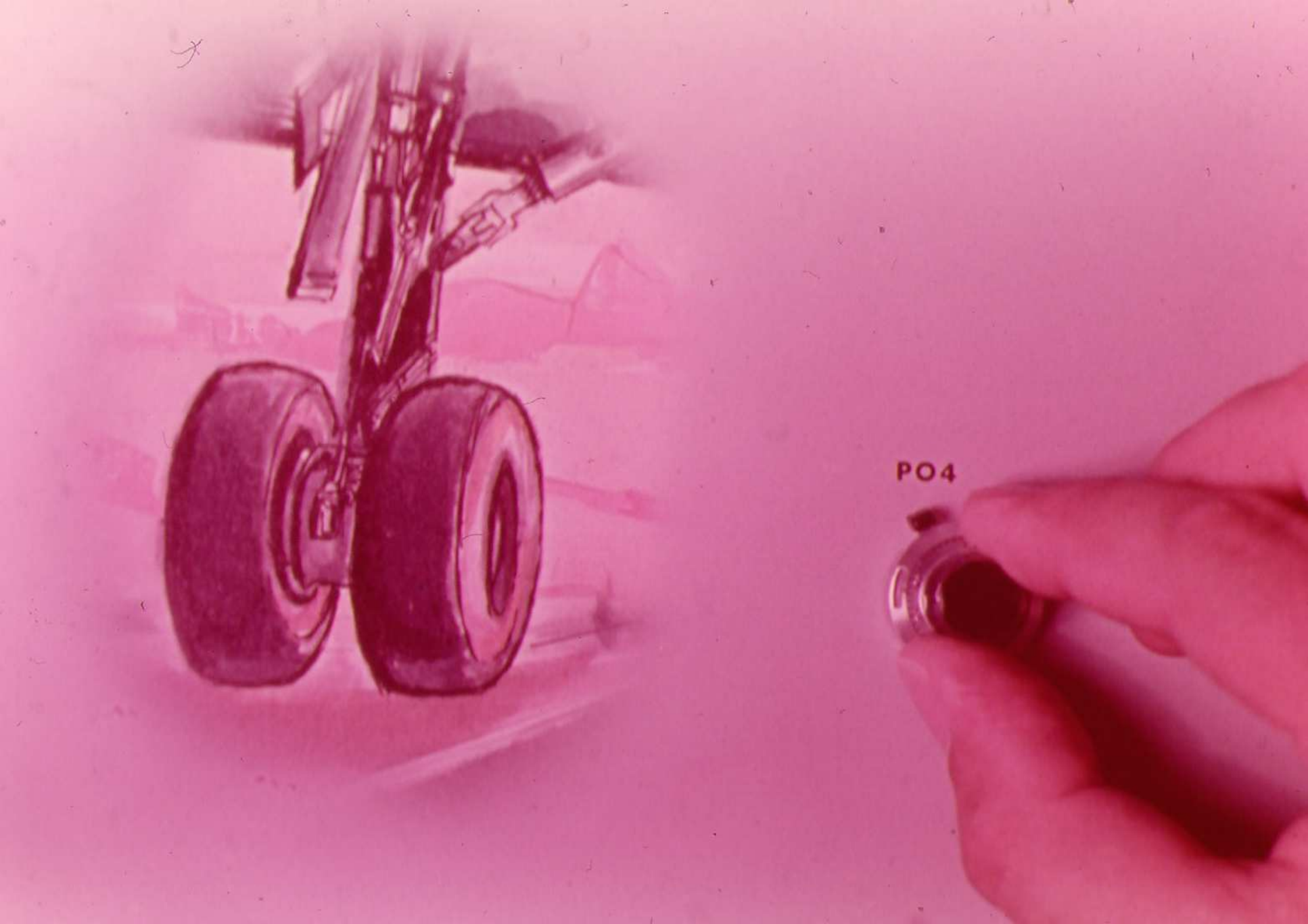
$$\ddot{x}=-\frac{1}{M}(D\dot{x}+Sx)$$

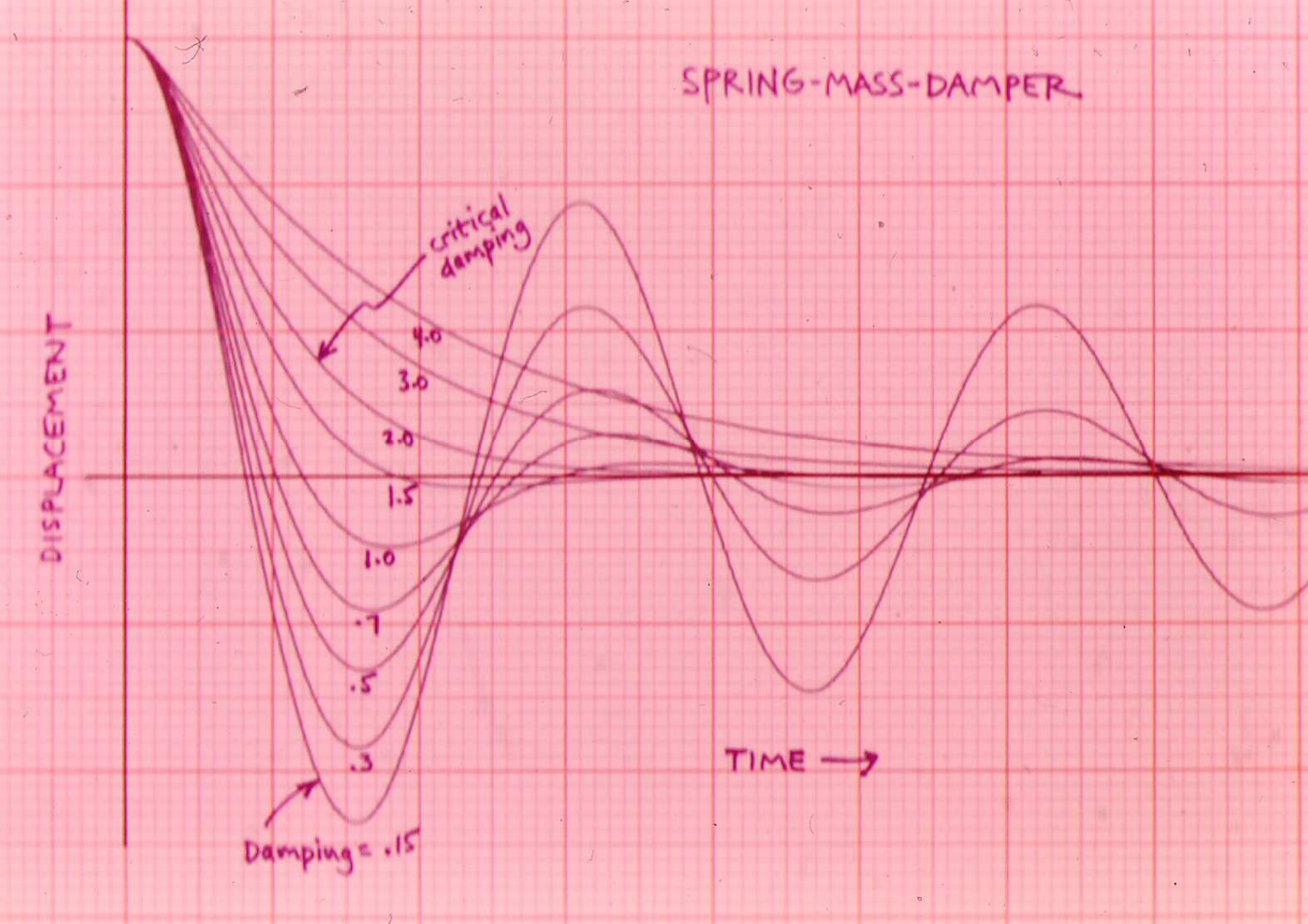


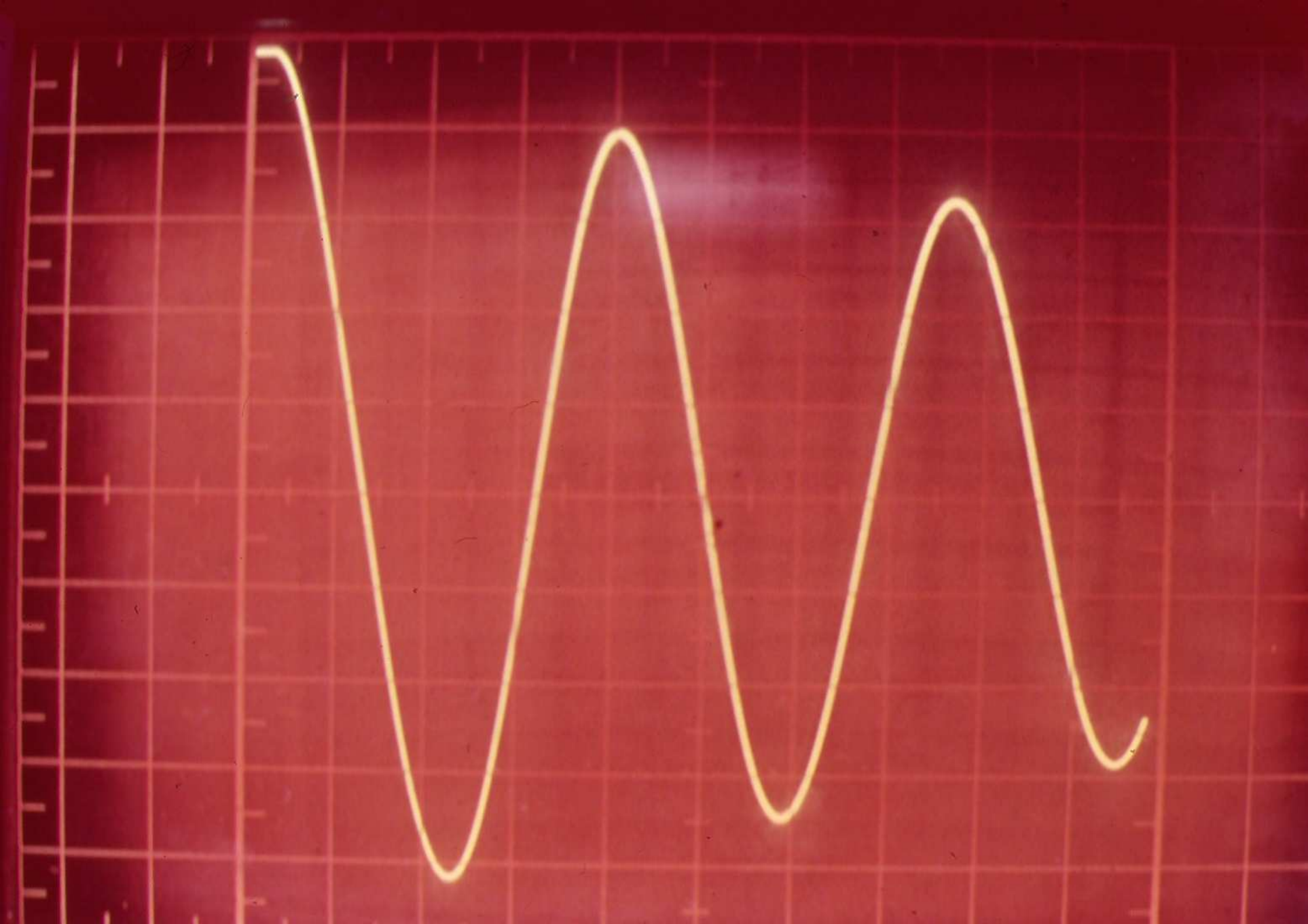

RJ
IF
Hi
Lo
DUAL AMPLIFIER
0.6.0614-1
0.12.1611
POT.COMP.
0.42.0340
QUAD AMPLIFIER
0.6.0704-2
0.7.0148

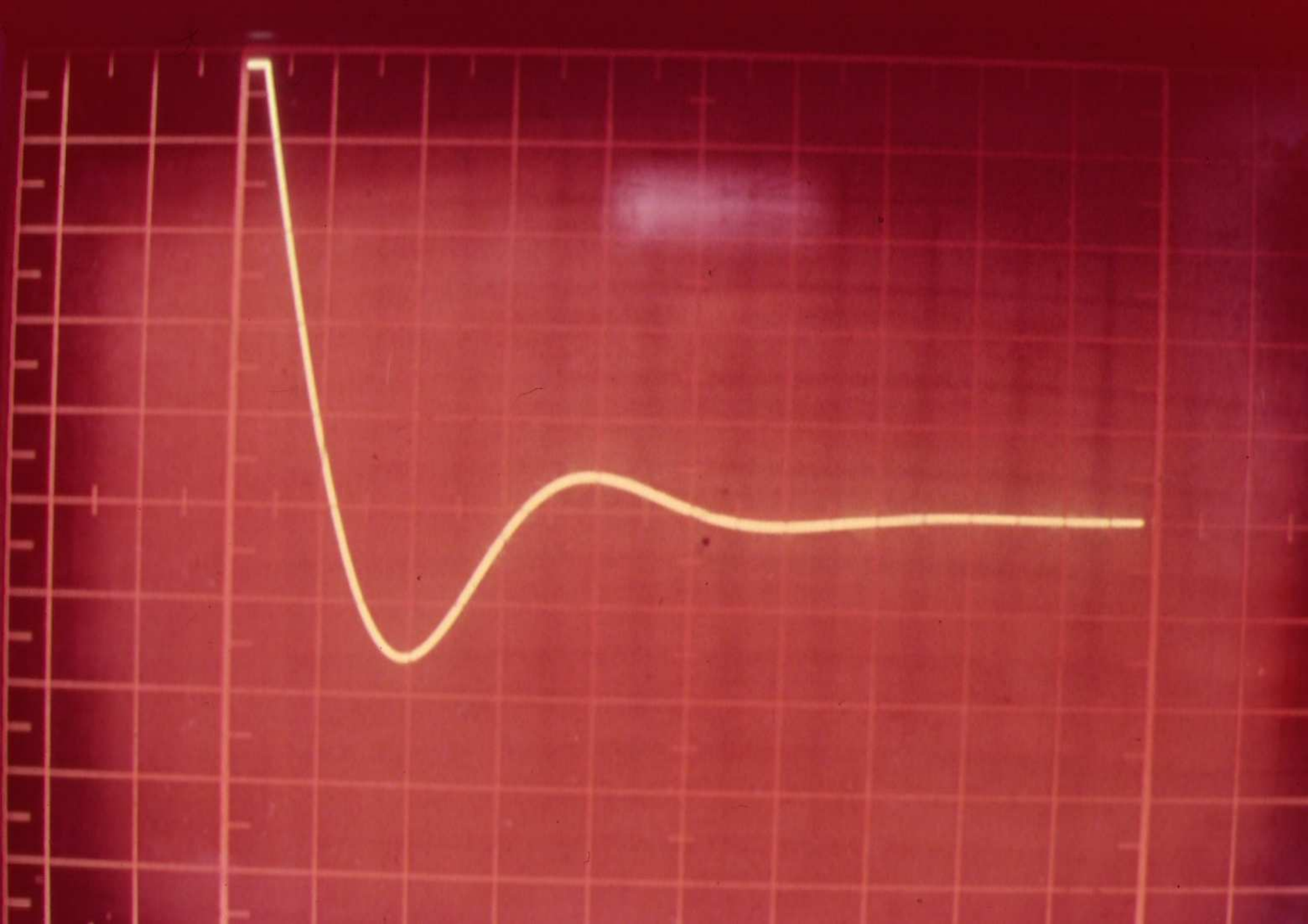

ATTENUATORS
P00
P01
P02
P03
P05
P06
P07

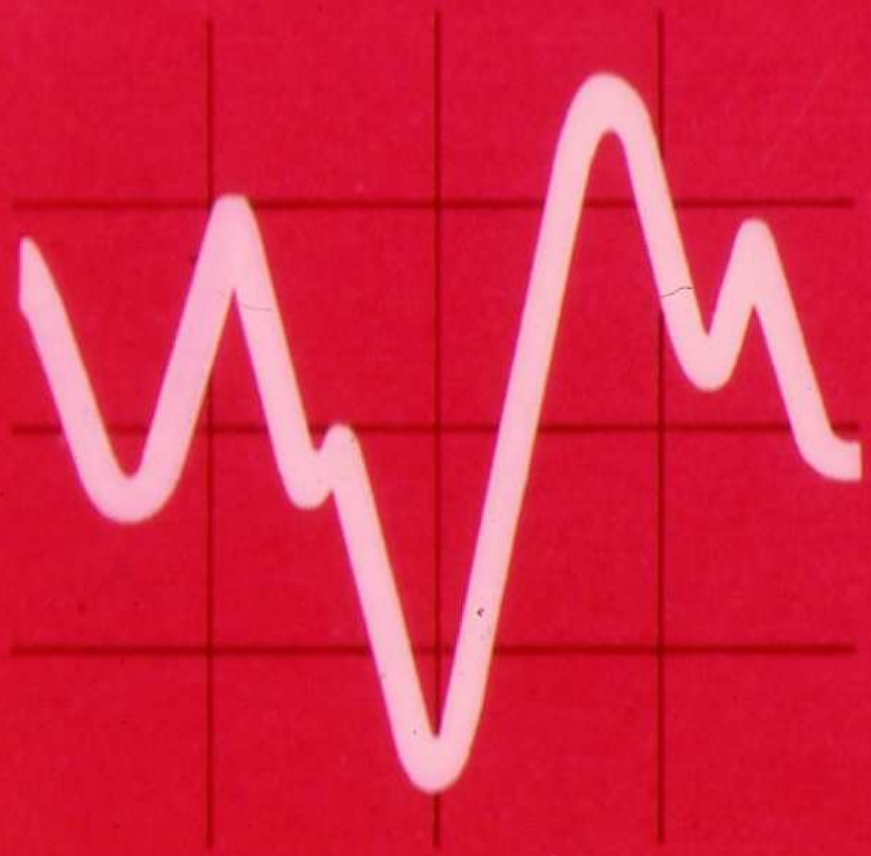

DISPLACEMENT
TIME


PO4


SPRING-MASS-DAMPER
DISPLACEMENT
TIME →
critical damping
4.0
3.0
2.0
1.5
1.0
.7
.5
.3
Damping = .15







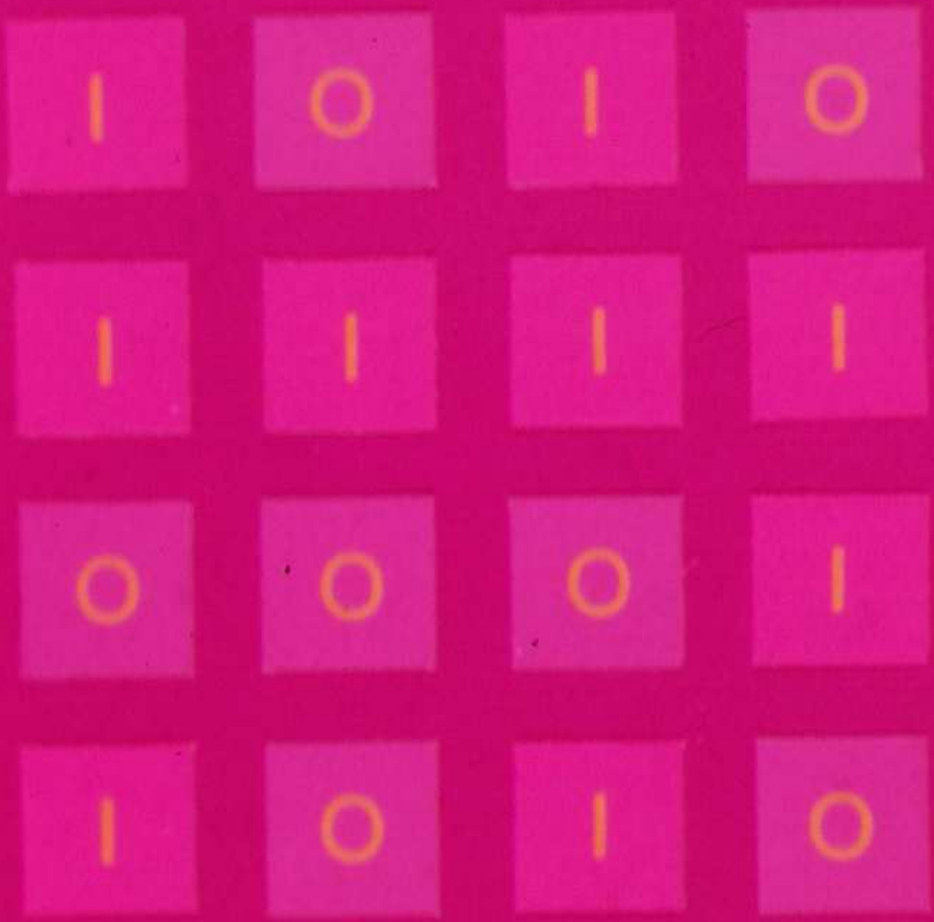
Analog Computer Concepts

ANALOG COMPUTER CHARACTERISTICS

1. VARIABLES are VOLTAGE levels
2. OPERATION is CONTINUOUS
3. SIMULATES physical system
4. REAL, FAST, or SLOW TIME

ANALOG/HYBRID employs DIGITAL LOGIC elements for

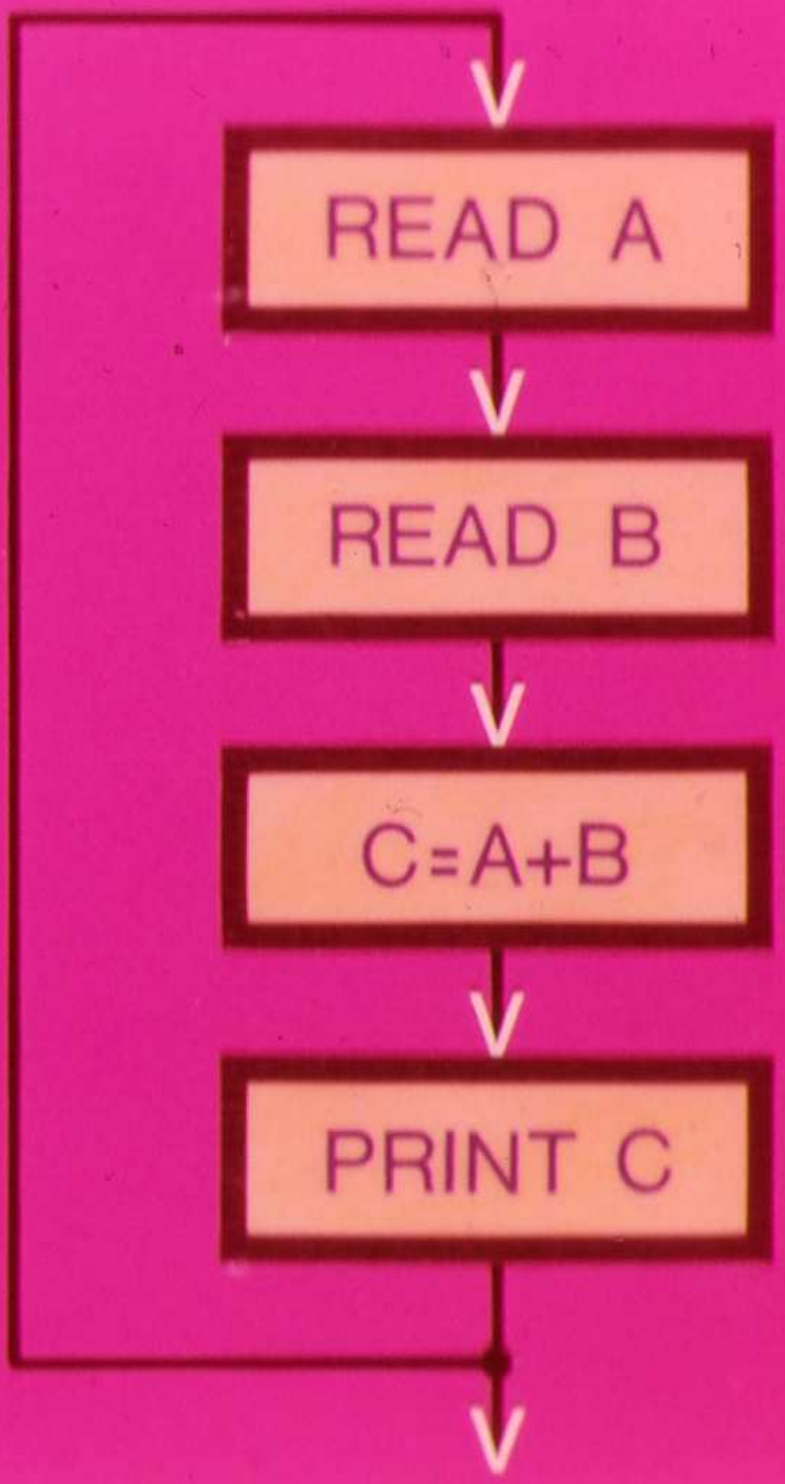
DECISION-MAKING AND CONTROL

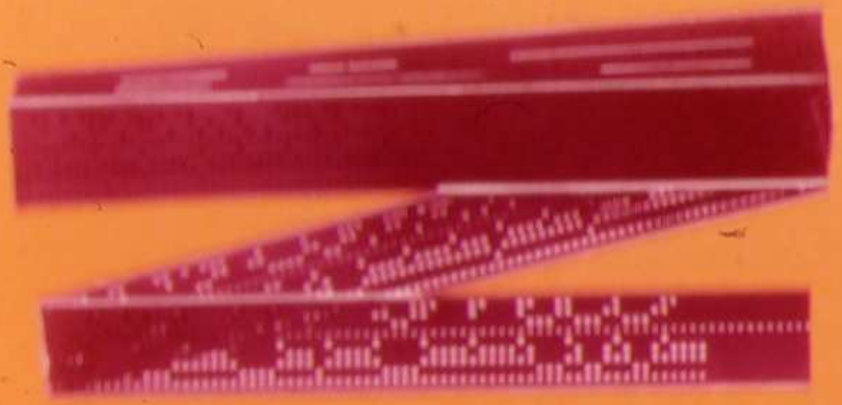


Digital Computer Concepts

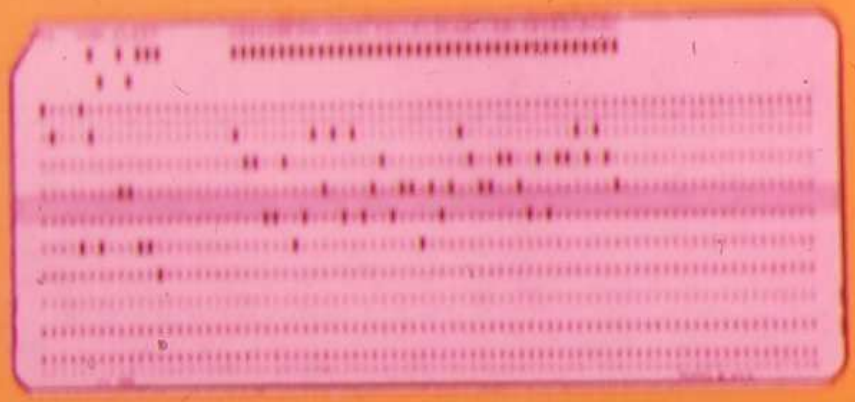
DIGITAL uses BINARY number system

DIGITAL operation
is SEQUENTIAL





Punched Tape



Punched Cards

Magnetic Tape

Keyboard

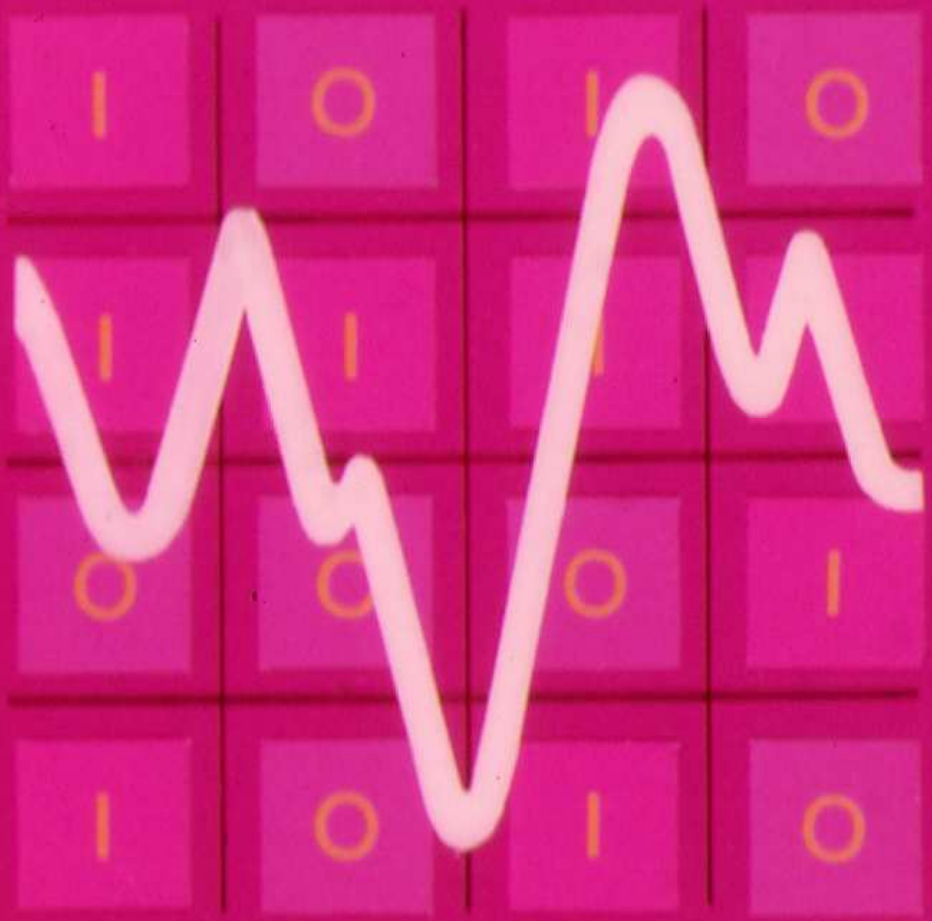
.12483939+

.13747727+

.14966629+

.16155494+

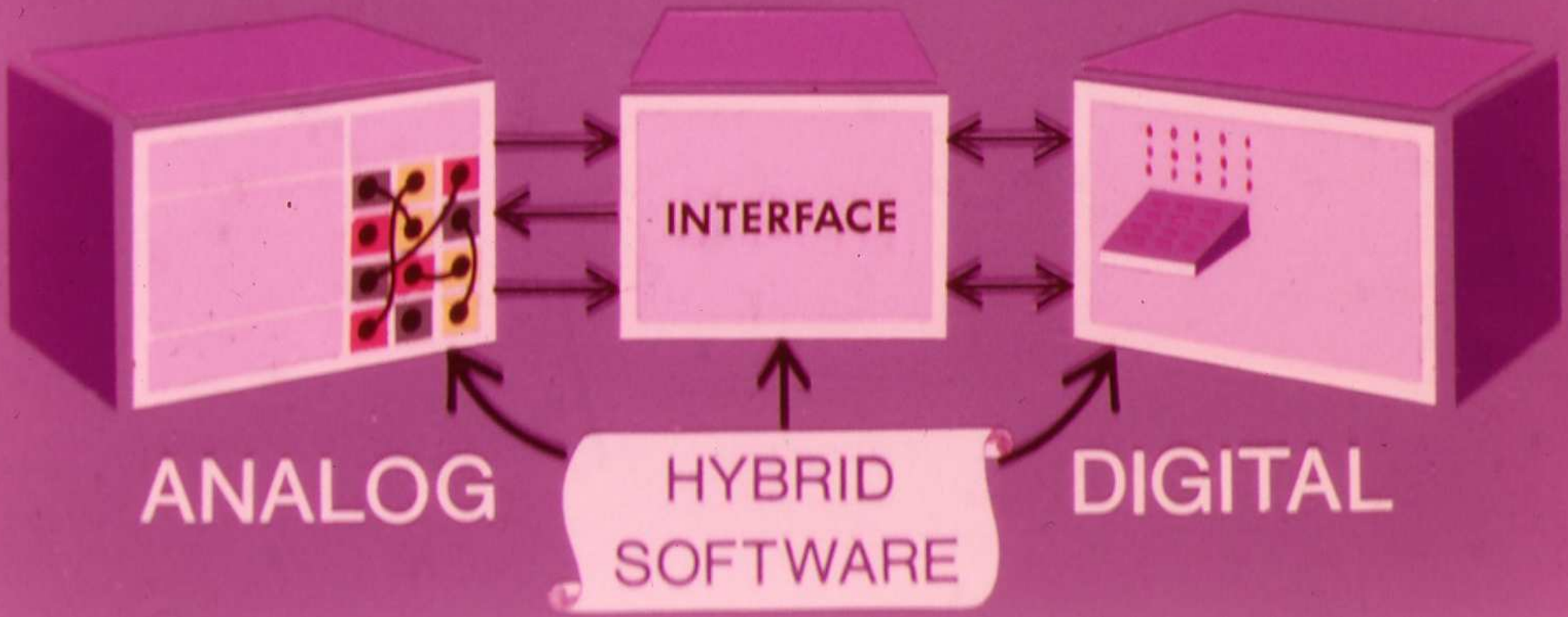
.17320508+

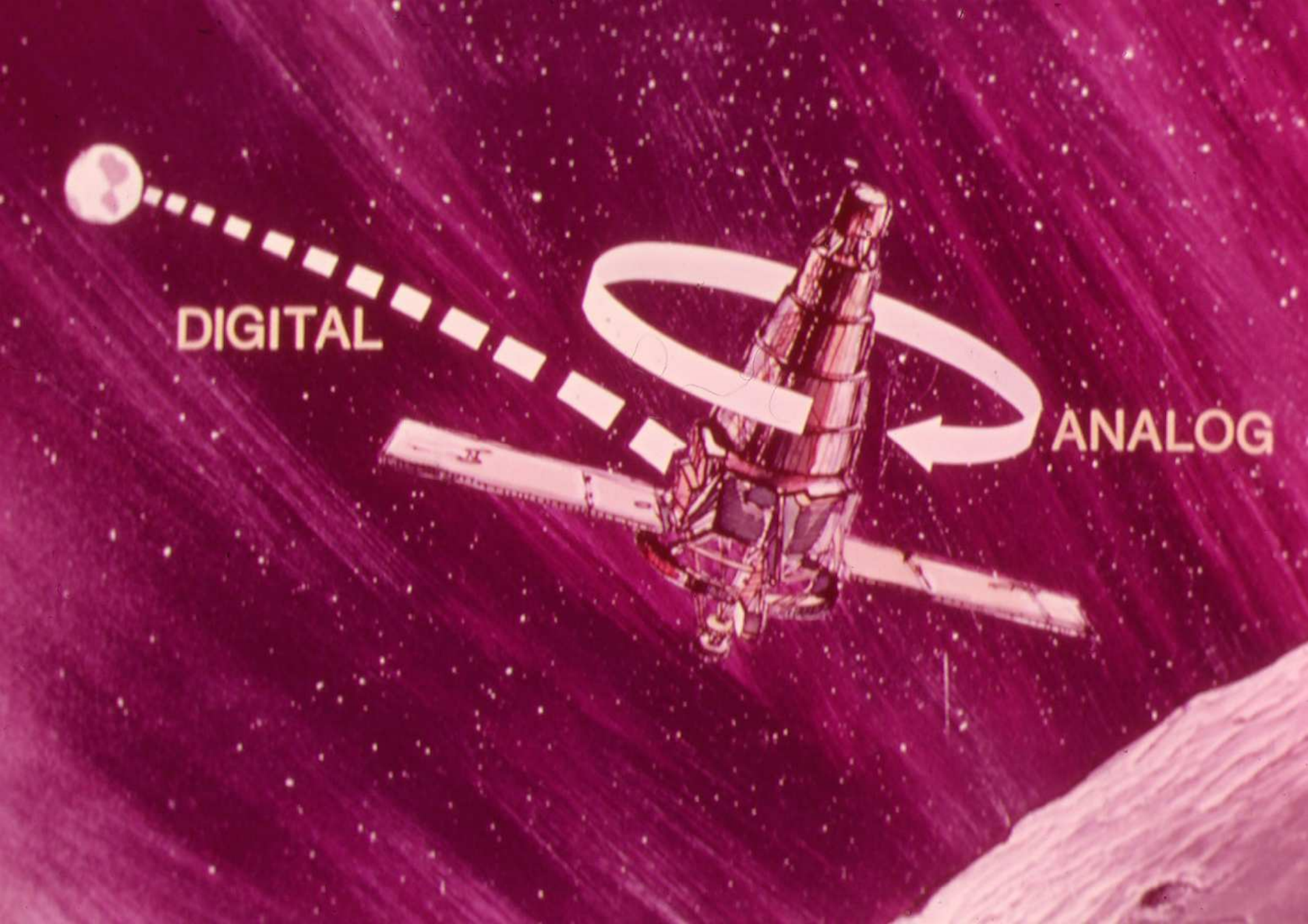


Hybrid Computer Concepts

HYBRID SYSTEMS

combine the best features of both Analog and Digital




DIGITAL
ANALOG

Analog solves by SIMULATION

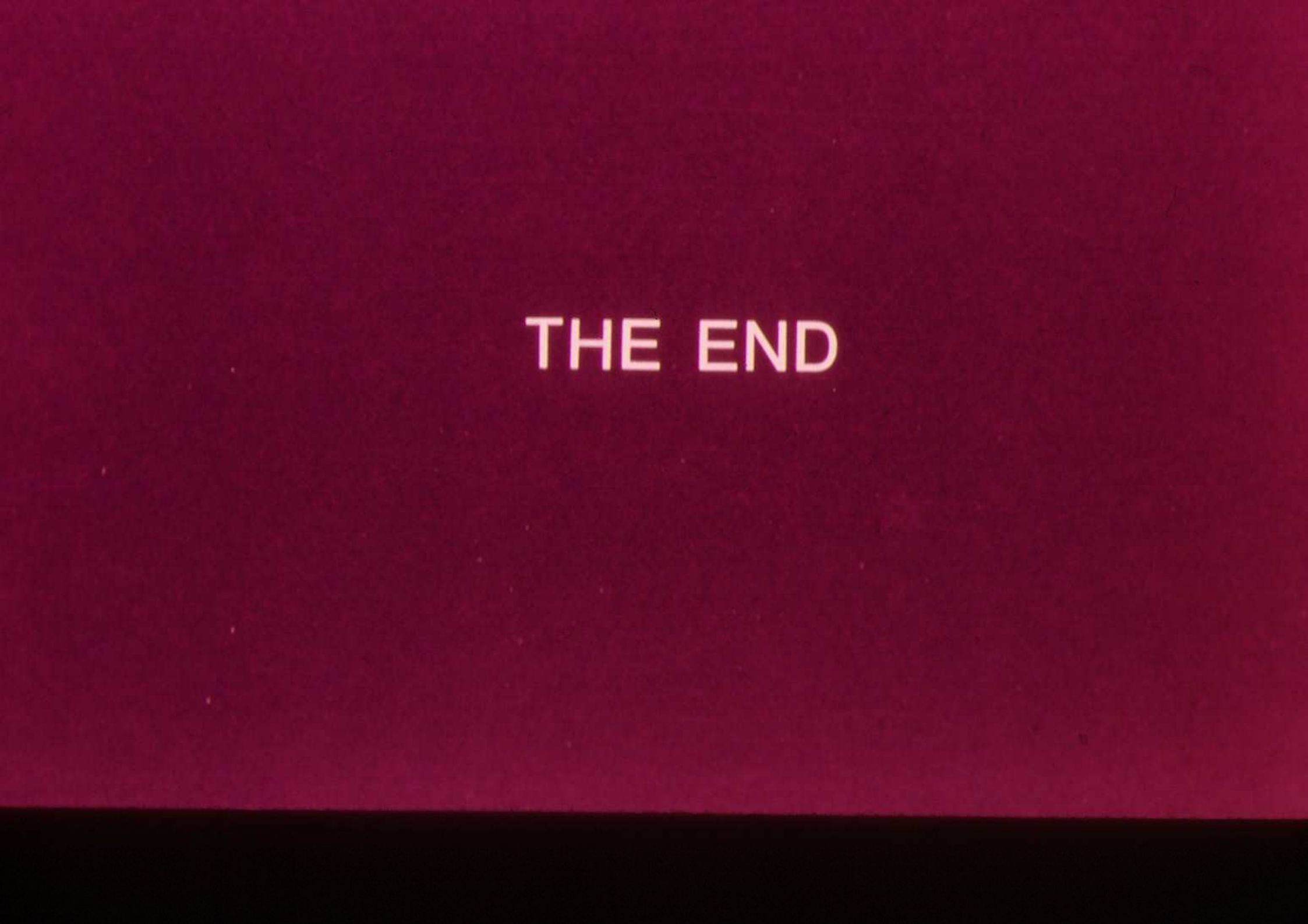
Operation is CONTINUOUS

Components operate in PARALLEL

Time INDEPENDENT of problem complexity

Analog/Hybrid employs LOGIC elements

Used for solving DYNAMIC PROBLEMS


THE END