

Timing and Animation

Excerpted from Timing for Animation by Harold Whitaker and John Halas

- Timing is elusive; only exists while the animation is project or played back.
- Hard to explain in words whether it works or not
- Hard factor to quantify; something that works in one situation might not work in another situation
- Look at laws of movement in nature
 - What do movements mean
 - What do they express
 - How can these movement be simplified and exaggerated

What is timing

- Gives meaning to movement
- Achieved by drawing the same thing in two different positions and inserting a number of other drawings between the two
- Result is movement not animation – animation is not just movement but how the action is expressed by the underlying causes of the movement (newton's law of motion that things do not move unless acted upon)
- no matter what there is always a constant – the fps (frames per second) that the animation must exist within

What to be considered

- Gravity...
- way an object is built and its flexibility
- Mood, will, instincts that create movement that is animated



all objects in nature have weight, construction and degree of flexibility thus behave appropriately when a force acts upon it; animation as drawings have no weight, construction, nor forces acting upon them – animator must give meaning to movement as specified above think also of exaggeration of tendency of the weight to move in a certain way and not the specific weight of an object in and of itself. Animation works when artist give these drawings the impression of reacting in an exaggerated way when weight and forces are made to act upon them.

Limited Verses Full Animation

Limited animation

- More economical – as many repeats as possible within the 12 frames per second
- Holds are lengthened to reduce number of drawings
- As rule in 24 frame animation not more than 6 frame produced (3 for 12 frames)
- Requires skill on part of animator because must create illusion of action with greater sense of economy

Full animation

- larger number of drawings per second of action
- some require every single frame be animated to achieve fluidity

General Introduction

Readability of ideas depends on...

Good timing

- Preparing the audience for something to happen
- Action itself
- Reaction to action

Too much time to any of these things – too slow

Too little time – too fast

Timing depends on audience – children and adults different

Children – more slow paced

Adults – more fast paced

General Spacing of drawings

Halves, thirds, quarters

In order to graduate the space between two keyframes consider halves or thirds the space between; halves or thirds are most appropriate

*The Way an object behaves on stage depends not on how well it is drawn but on **spacing** of animation drawings on stage*

Spacing of Drawings = Timing of an action

Movement from position x to position y in 12 frames (1 second at 12fps) has closer spacing and slower movement than movement from position x to position y in 6 frames (1 second at 12fps) which has a faster movement.

- consider – slow or quick movements
- gentle or abrupt motion



Cause and Effect

When object is acted on by a force – force run through more flexible medium (caricatured matter)

Newton's Law of Motion

'For every action there is a reaction'

every object has weight and moves only when a force is applied to it.

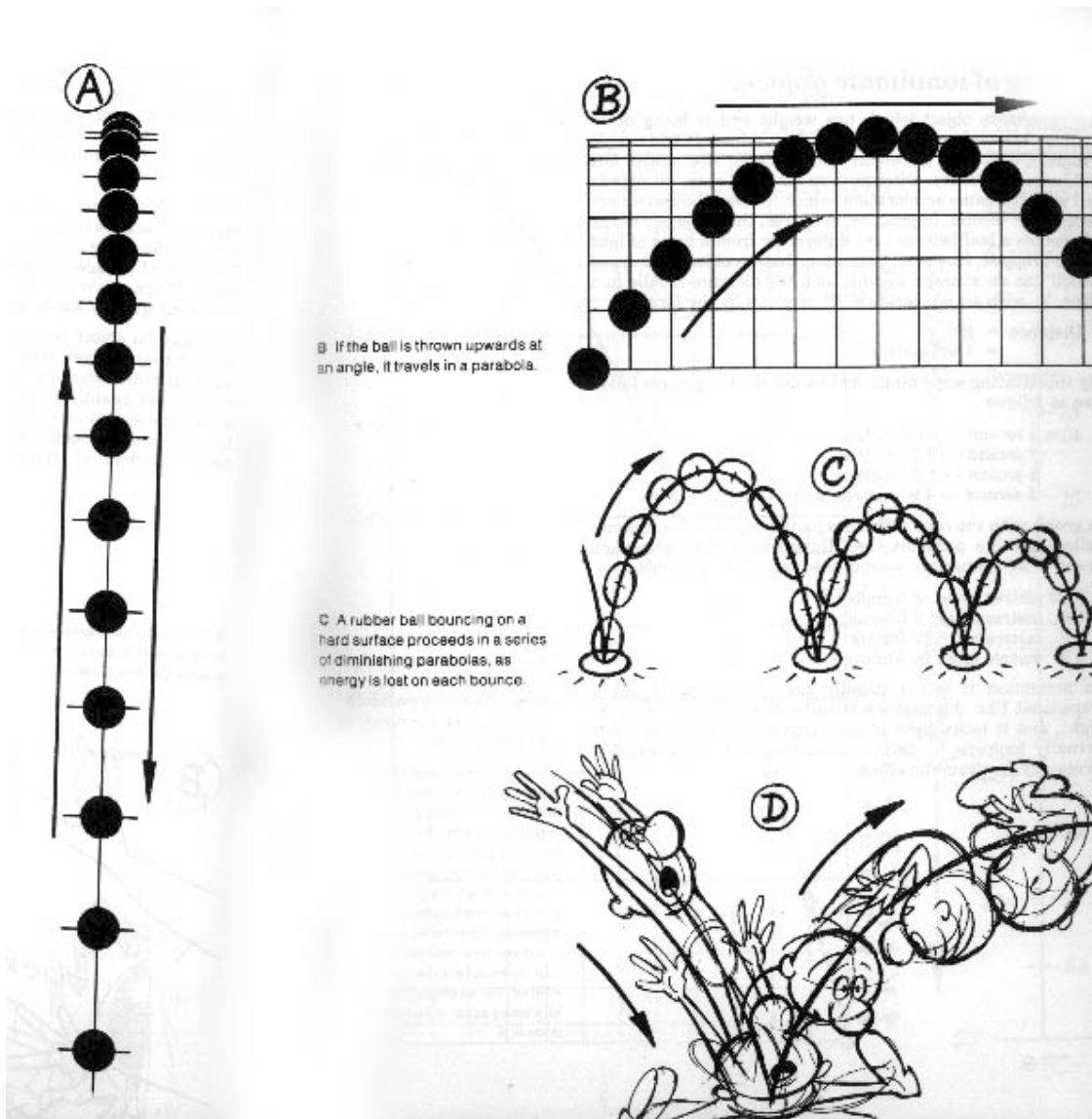
(Weight. fla)

Heavy Objects

The heavier an object is the greater its mass, the more force is required to change its motion or to get it to move in the first place

Light Objects

Light objects have less resistance to change in movement and so behave differently when forces act upon them.



B If the ball is thrown upwards at an angle, it travels in a parabola.

C A rubber ball bouncing on a hard surface proceeds in a series of diminishing parabolas, as energy is lost on each bounce.

Objects thrown through air

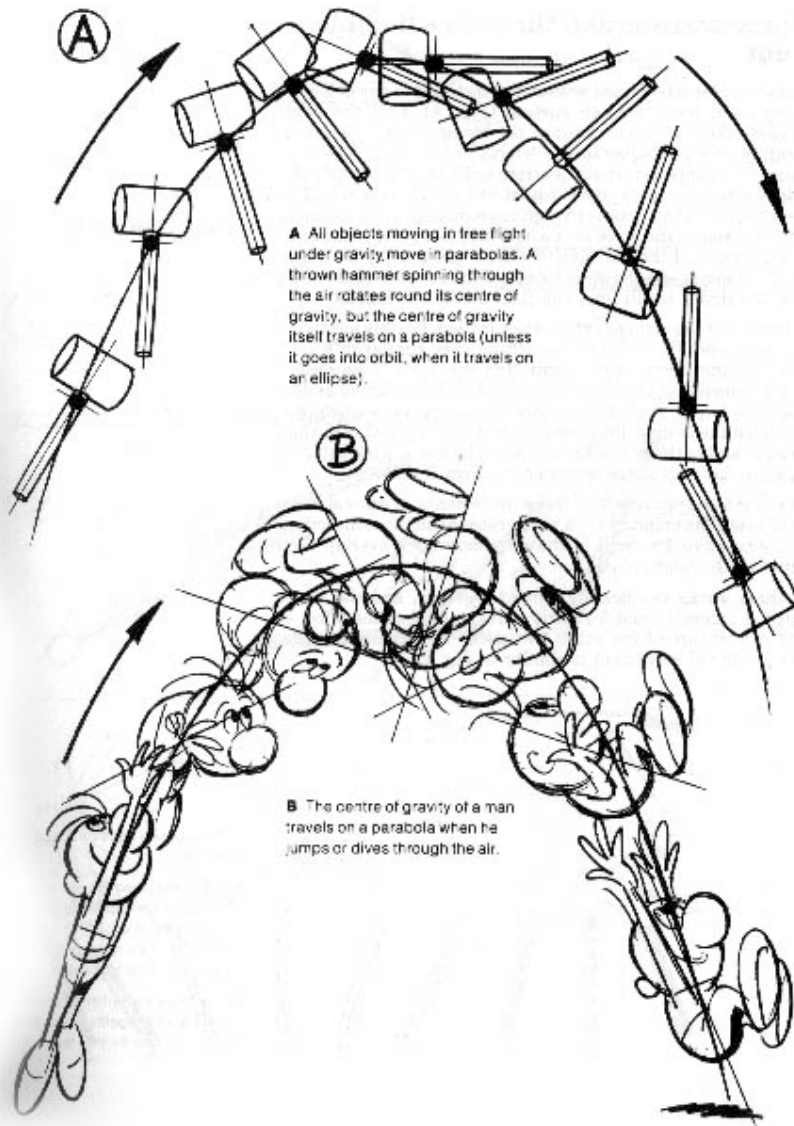
Object thrown vertically upwards – speed gradually diminishes to zero (at top) then starts to accelerate downward again.

If thrown at angle vertical speed diminishes but horizontal speed remains constant

Bouncing Rubber Balls

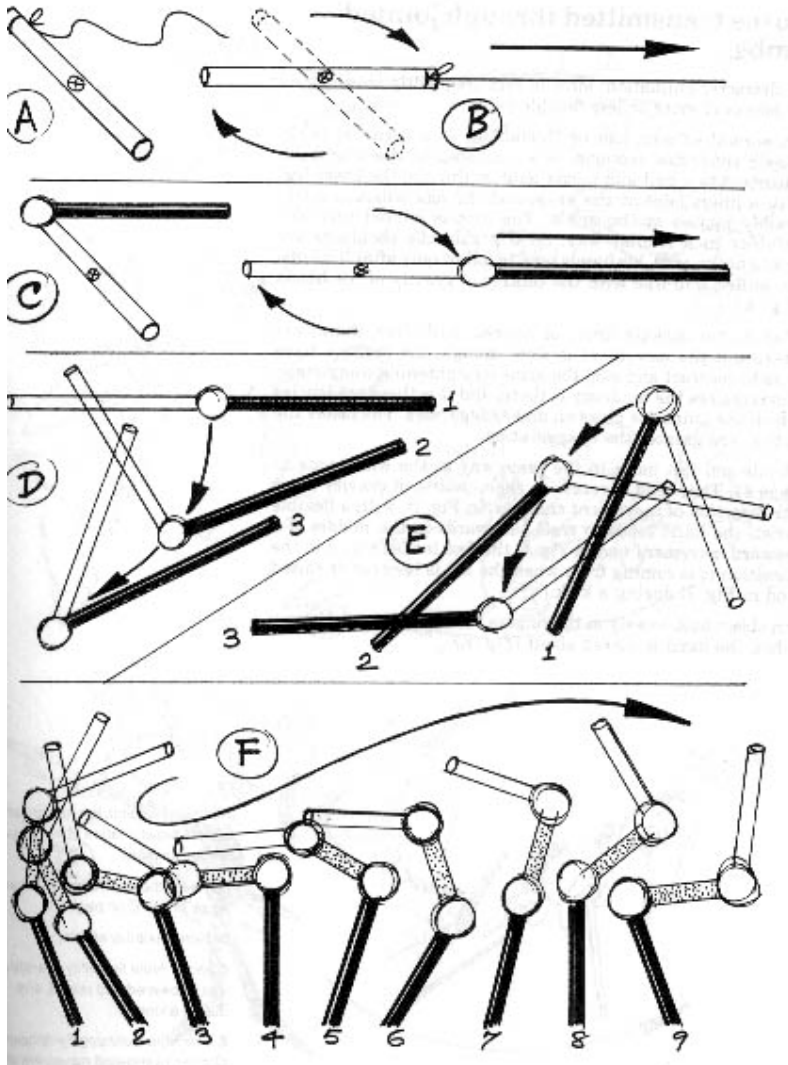
Rubber ball – bounces in series in a parabola; parabolas diminish in height each time as some energy is lost by the ball on the bounce

Drawings after the squash should be overlapped as the ball accelerates to maximum speed again. Usually bunch at top and spread at bottom.



Rotating Objects

Irregular inanimate objects - If irregular shape is falling or being thrown through the air, the movement of its center of gravity along a parabola can be timed. The object rotates on its fixed center along the parabola



Force transmitted through a flexible joint string and length of wood

1. string pulls taut
2. stick does not move while string is slack
3. weight of stick is concentrated at center so stick as whole doesn't move until center of gravity is in line with string; stick rotates until the axis of stick and string are in line then moves off

when the main stick accelerates or changes direction the successive drawings of the second stick overlap each other as the stick rotates

Direction Changes

Changes in direction start with an ease in (slow to accelerate)

The more friction – the slower the acceleration up to speed

Slow versus Fast Action

With slow action must be sure that there is absolute positioning between keyframes so there is no accidental jitter

With fast action must be sure that the audience is able to see the action (use anticipation and aiming together); sometimes fast action is so fast you can not see the movement but only the trace of the movement (use whizz lines)

Getting into and out of holds in position

Time it takes to reach a hold depends on the momentum of the object

Heavy object takes several seconds to stop and simply slows into a stop
Avoid having entire object come to a stop (unless it is rigid); if object is flexible parts of object stop before other parts.

Loose objects or extremities take longer to stop and continue to move afterwards (overlapping action) – moving out of a hold and the extremities are pulled afterward. Object will pull back (anticipation) before shooting forward.

Single frames or double frames

Single frames – each frame is a separate and different drawing

Double frames – every other frame is a separate drawing

Single frames for complex motion, smoothness, for placement of more information about the motion in an animation

Double frames for time-saving and simpler animations

Hold (how long to hold)

Consider reading time for text

Anticipation

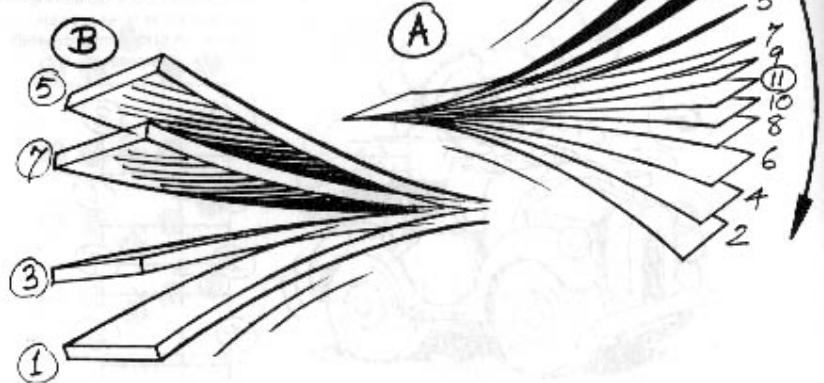
Equilibrium (object within context – is it holding for tension or stability)

Amount of anticipation equivalent to speed of motion to follow

(more violent movement needs a more stronger anticipation)

- Movement attracts the eye to where the next motion will take place
- Use to preface very face exits or motion on screen that is important to see
- If anticipation is well done then only the action itself needs to be suggested (such as in whizz lines, or extremes in keyframes...)

- A A vibrating spring, animated on single frames.
- B The slower vibration of a springboard.



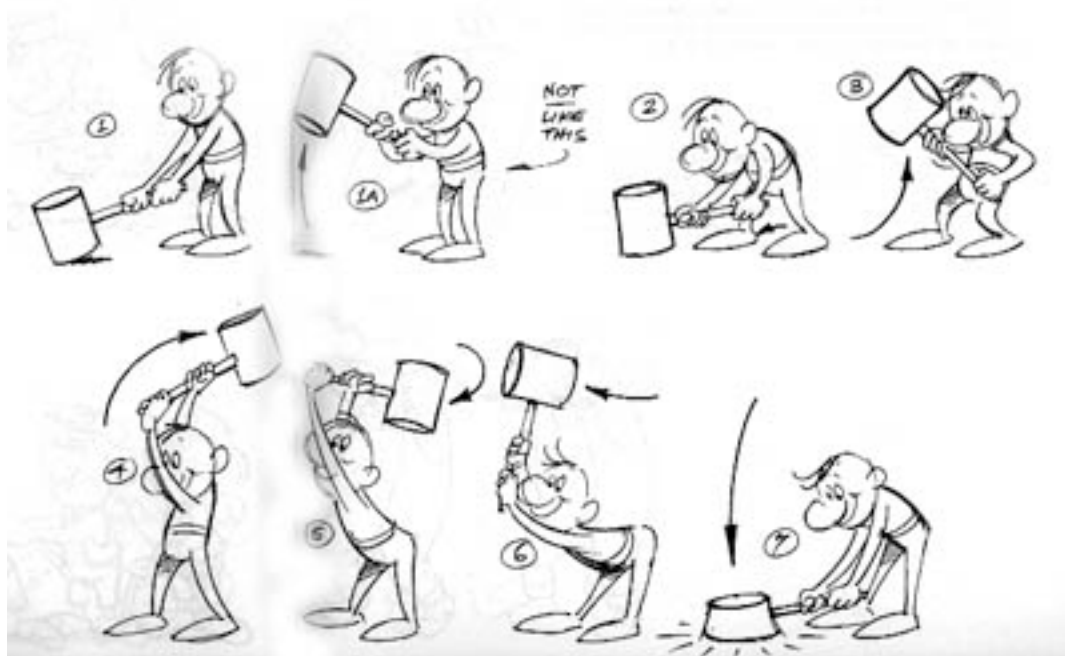
Timing an oscillating movement

A **very fast oscillating motion needs no inbetweens** but a gradual settling of the object into stasis as it comes gradually closer to the resting position.

In any action in which the direction of the movement reverses at the extreme, it tends to come out of the extreme more slowly (gives more snap to the movement)

Cycles of less than six frames may look mechanical and be worth doubling the length of the cycle with two different variations of the movement or instead of a repeat of 4 frames use a doubled length cycle of seven or nine frames so same positions do not appear on two consecutive repeats.

In to and fro movement which same drawings can be used in reverse an optical problem arises at the ends of the movements (repeat frames have greater impact on eyes than extremes – in 1,2,3,4,5,6,5,4,3,2,1,2,3,, 5 and 2 occur twice so impact on eye is stronger. Skip deliberately one of the 5 or 2 frames in the repeat. Or change the reverse so there is a completely different drawing.

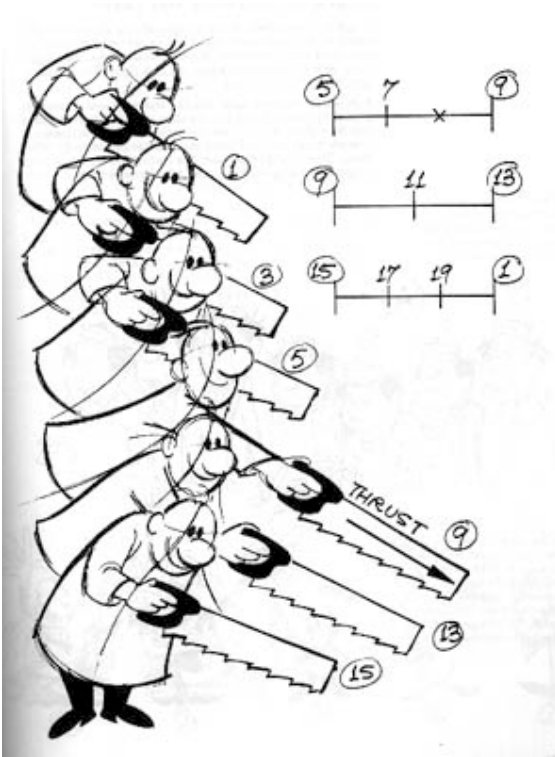


To make something look heavy

consider the weight of object whether it is light or heavy and the amount of force it will take to move it.

Light object = little effort to move

Heavy object = greater effort to move and slower to move



Timing to suggest force

relationship in time between the object being moved and the mover object; if there is a lot of effort to move an object then slow in to push with a slower acceleration and overall velocity and a slow in to pull with a faster acceleration.

Timing and size of object

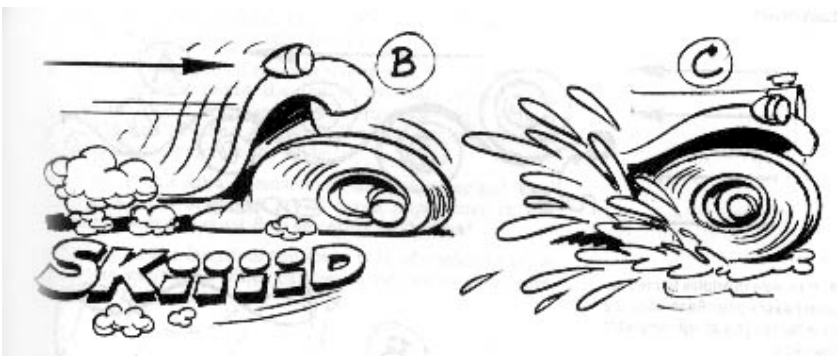
Big - Bigger the object the slower it seems to move; harder it is to stop (ease out) and start (ease in); Any change of direction is met with obstacle

Small - Smaller object faster, lighter movement (as if in gravity-less environment)

Action of flames = scale of fire

Big fire – slower wavelike movement

Little fire – flickers quickly



Friction, air resistance, wind

Sudden stop with large object – lean with weight low with body (In case of character) as far behind the feet as possible; with a car and as its brakes are put on – car leans backward as the tires squash with as much base on the ground as possible

Wind shown mostly by effect on another object (such as leaf)

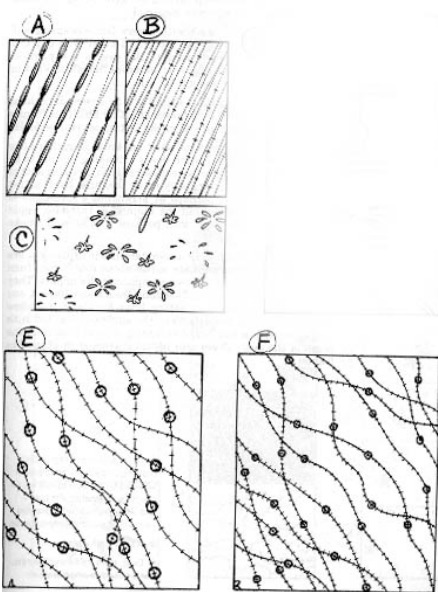
Timing cycles (how long a repeat)

Piston – 8-10 frames for two paces and 1 drawing per frame

Fire burning – (not very repetitive) require extra cycles of approximately one second or more – extra cycles = variation in frames – animation fast at bottom of flame and slower where it curls up. Conical shape (roughly); fluid and ever changing.



Smoke – need a repeat of a second or more; repeats on drawings become closer and closer so that speed slows as same time that the smoke disappears. Many variations of smoke so that it is implied on not literally drawn (deep structure).



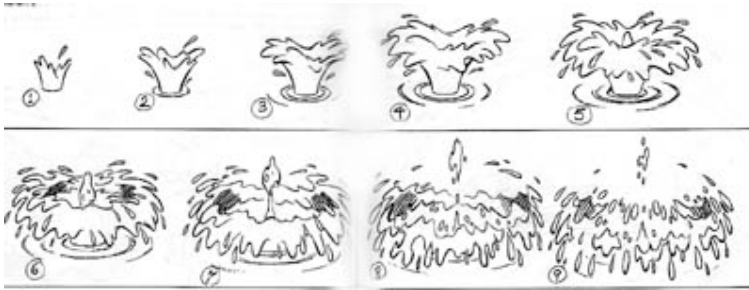
Snow – several seconds for variation; wavy lines and longer cycles than rain to avoid audience noticing same flake falling down the same track. 2 seconds for a flake to cross screen. Varied sized flakes for depth.

rain – to keep rain from looking mechanical animate with random slope. Time it moving quickly down; distant rain moves more slowly (background) and close up rain moves more quickly (foreground). This gives depth.

Drawn as straight lines with consecutive drawings overlapping slightly. Needs at least 1 second of animation if not more for it not to be mechanical.

water drops from rain are chaotically placed on surface – randomly placed.

Vertical rain represents miserable mood; tilted rain can be more violent mood.



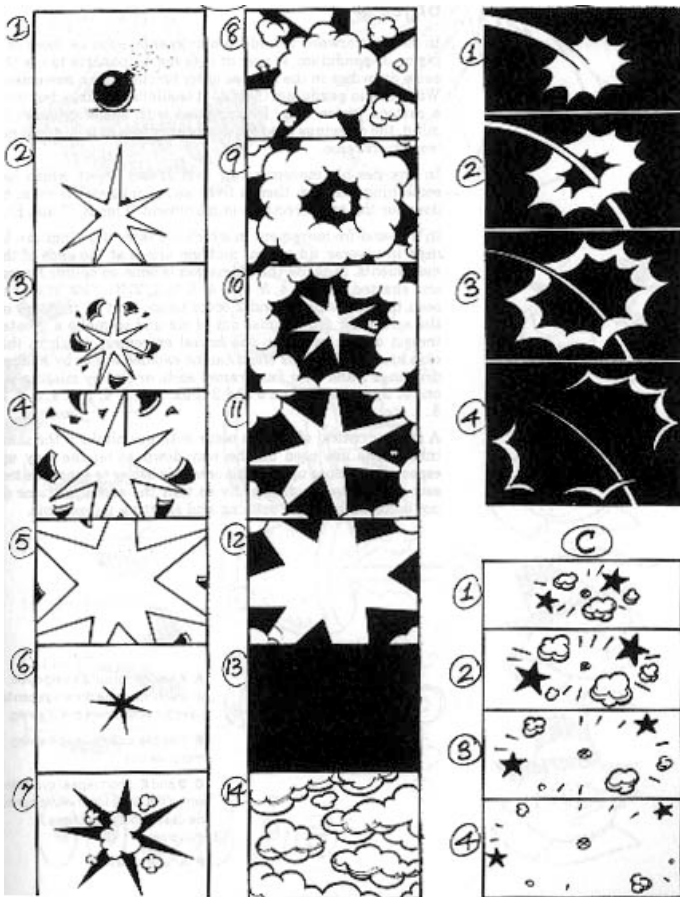
Water – no mechanical strength and peculiar to its properties; in splash each little drop making up the mass of water at the start proceeds on its own trajectory (parabola) – water radiates out from central point. Starts as mass of water spreading out in irregular sheets held together loosely by surface tension...

What does this mean...

As spreads, surface tension breaks down and sheets disintegrate

Little object drops into the water – just ripples out from center

Big object drops into the water – splash and little waves from center



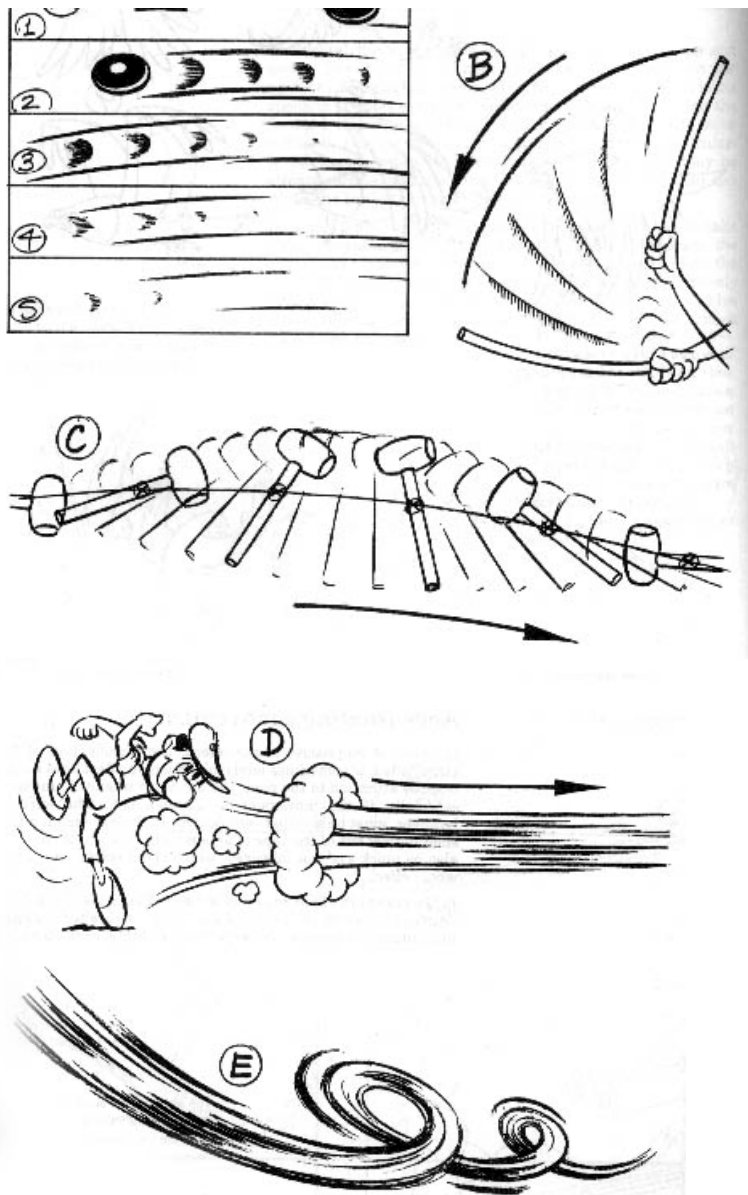
Explosions

Intended to shock audience

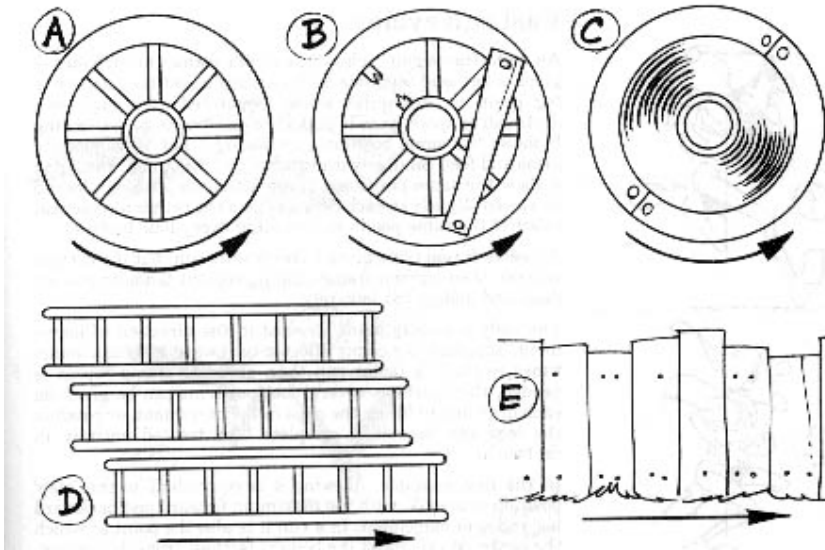
Start with fast movement and taper off to slow finish – use short anticipation, which attracts eye to point of explosion just before it happens. 4-5 frames for this.

Dry brush (speed lines)

Should be timed quickly so that by the time the audience is aware of it it is gone. (3 frames approximately)



Drybrush is something left behind by the object causing it. Can't move with object or effect lost. Use sparingly and saved for situations where drawings are widely spaced that the eye has difficulty in connecting them up.



Strobing

Strobing happens in objects with equally spaced elements; rungs on ladder or wheel. Rungs can flicker – cannot distinguish direction of movement because there is no variety in repetition of object.

Change object patterns a bit (B above)

Or void out repeating cycle completely (C above)