Two Studies in Animation

Irene Feingold

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TWO STUDIES IN ANIMATION
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OF THE ROCHESTER INSTITUTE OF TECHNOLOGY

DATE: MAY, 1974

ADVISOR'S NAME: R. ROGER REMINGTON
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CHAPTER I

PURPOSE OF THE THESIS

The purpose of this thesis is to research the area of creative and technical animation using the RIT/TV mark to show creative animation and the mechanics of the Wankel engine for technical animation.

The RIT/TV mark and the Wankel engine served as a tool in the development of the skills needed for basic creative and technical animation. I investigated the correct timing and rhythm to achieve visually smooth motion. The cells were done in color, registration on the Oxberry punch system and the film was shot 16mm to achieve maximum quality. The Oxberry animation crane was employed so I could achieve maximum visual quality. The RIT/TV mark is a 10 second identification and the Wankel engine runs 45 seconds. The finished film is delivered as one 16mm silent print.

Procedures: The project and the report was done simultaneously.

1. Research the mechanics of the Wankel engine.

2. Research aspects of technical animation.

(Due to the lack of literature as to the physical aspects of animation, correct rhythm and timing required trial and error.)

4. Execute animation and set timings.

5. Shoot animation.
CHAPTER II

INTRODUCTION

Animation has been a long standing fascination of mine. The abilities of the artist to make creatures and objects come alive and display any type of movement and project an image or personality is a great creative and technical fete. To conceive a creative animated idea is a lot easier than the actual physical and technical art of carrying out the cel work. Especially, when you take into consideration that every second of motion must be subdivided into 24 units. There are many books written about the great cartoons that have been created, but they fail to explore the technical problems and solutions behind these creations.

"At the beginning of his career, Walt Disney, took a humble branch of the motion picture industry - the animated cartoon- and within a dozen years, transformed it into a new art form capable of sustaining complex and subtle ideas."\(^1\)

With the use of the Rochester Institute of Technology Television Logo and the Wankel Engine these animation concepts are explored. The Rochester Institute of Technology Television Logo is a creative project. With the logo, I could map out the possibilities for the 10 second station break, and then animate from my design.

The use of animation as an educational tool provides the possibilities to explain and show the movement of complex items. By slowing down the motion of an object, its function and parts can be explained easier. The Wankel Engine, animation captures the movement and shows the workings of this new concept which could revolutionize our transportation system. This animation duplicates the actual workings of the machine.

Animation is the most disciplined of the technical and creative arts, because it deals with time, light and the maximum of precision.
CHAPTER III

HISTORY OF ANIMATION

The first experiments of movements were conducted by Eadweard Muybridge. He did "a series of photographic images made in rapid succession at properly regulated intervals of time, or of distance that would definitely set at rest the many existing theories and conflicting opinions upon animal movements generally."

Thomas Edison experimented with the idea of motion pictures and in 1889 built the first Kinescope, a peep show viewer which held 50 feet of film and ran for 13 seconds.

The Cinematograph, in 1895, by Louis and Auguste Lumiere, was able to project the moving picture on a screen.

But the invention of flexible film by George Eastman in 1889, was what was needed to revolutionize and stir this industry. It was not until 1906 that J. Stuart Blackton produced the first crude and rudimentary effort in animation. His drawings did not seem to move, but completed themselves. This sparked the imaginations of other artists.

---

Animation has always been a tedious task. In 1913, Earl Hurd invented the idea of painting animated figures on celluloid which revolutionized animation procedures. Previously each drawing for an entire sequence had to be drawn completely... With the use of "cels" only the moving characters required attention. This system was time and money saving so it was adopted by the entire industry.
CHAPTER IV

TECHNICAL ANIMATION: THE WANKEL ENGINE

With the automobile a major contributor to air pollution, anti-pollution devices and alternatives to the standard piston engine are being explored. In 1924 Felix Wankel, a German inventor, who throughout his 70 years did not obtain a driver's license, started his work on the rotary engine. Felix Wankel considers himself having a one-sided gift, since he never finished high school or attended college. This gift was to make technical drawings. It took him thirty years to fully develop the engine.

The Wankel engine and the standard piston engine both take in gas, compress it and explode the gas. The engine's function is basically divided into four parts: Intake, Compression, Combustion and Exhaust. In the Rotary Wankel engine a four stroke cycle completes one revolution. The first chamber starts the cycle by drawing in an air and fuel mixture. This is intake, the first stroke. As the rotor revolves, the space in this first chamber is reduced, gradually compressing the mixture. The second stroke is the Compression. When this mixture is fully compressed, two spark plugs insure complete combustion. These expanding gases provide the energy to drive the rotor. This Combustion is the third stroke. Finally this revolving rotor
expels the gases at the base of the engine block. The
Exhaust is the fourth and final stroke. The cycle begins
again. All four strokes described are always in motion.

In order to animate these functions a complete know-
ledge of the rotor mechanics must be achieved. Not being a
mechanically inclined person, I assembled a prefabricated
injection mold model of the entire engine as it is being
produced for cars today at a scale of one-third the actual
size. This battery operated model made the mechanical
functions fully visible. This model proved to be of great help.

Now the actions of the engine could be divided into
stationary and moving parts. The actual spatial relationship
could be measured and duplicated. The model revealed that the
outer gear is attached to the rotor itself. All the cel layers
for the animation had to be established. One layer was to
include all the stationary functions. Every other cel would
build off of this one. It was then established that the revo-
lution of the rotor was a separate cel series. In storyboarding
the action, I discovered this action was basically on twelve
segment repeat. Taking the rotor into a position at the base
of the stationary engine block, the twelve segment series was
established. Getting the twelve segment movement precise was
highly technical and of critical importance. It required
several trial and error visualizations. This was critical be-
cause it was a cycle and the beginning and end had to flow as
one continuous unit. There could not be any noticeable switch as
the beginning and end met. Basically there was to be no beginning
or end—a continuous flow. Once this rotor movement was established, all other animation was directly related to it.

The model again proved to be a great help. Once these foundations were laid, two series of the four stroke movement had to be visualized. One was to show the entire movement in a step-by-step revelation—taking the Intake, Compression, Ignition and Exhaust as a series. The second series takes these four strokes and shows them all functioning together, a realistic full-flow animation.

The spark plugs going off in the Ignition stroke were originally planned as overlays. Later the spark plugs were incorporated into the segmented and full cycle flow series. Lastly the titles were to be layed in. They would be dealt with as a small separate series.

Before any visualizing could be done, all analysis and each cel layer had to be established. As each section was being worked on, all the others had to be taken into consideration. A shooting schedule also had to be planned.

The 16mm film on which this animation was shot shows 24-frames-per-second. This animation was developed to be a 12 cel artwork per second; thus each cel was to be shot twice to make the total 24-frame count. As the cels were developed, a shooting script was maintained. The twelve segment repeated three times to complete one full turn of the rotor. This means that 36 cels times two frame exposure makes a total of 72 frames for one entire revolution of the rotor, or a full two-and-a-half second viewing on the screen.
The Wankel engine animation consisted of several smaller animated segments to be brought together and to work as one finished piece. They are the animation of the rotor and crankshaft itself, the segmented and total fuel cycle movements, and the titles. After the amount of cels for each section were calculated an animation shooting script had to be devised. An animation shooting script is an outline of the camera movements, cel placement and frame count. It acts as a guide to eliminate error in shooting. If an error is made, the script locates the error and makes it easy to find and correct your error.

The rotor series consisted of a twelve cel repeat, and the segmented motion a 41-cel single use series.

This animation was shot on a 16mm Oxberry camera, thus all the cels were pin registered to the Oxberry standard. The Oxberry camera was designed exclusively for shooting animation. It is well accepted for its excellence by the industry. It is known for its capability of very precise single framing.

This preliminary basic shooting script deals only with the cel animation itself. It does not include camera movements or a frame count. The preliminary basic shooting schedule was devised:

1. Title: Rotary Engine
2. Rotor spins with title on
3. Title off
4. Segmented motion series with titles popping on
Each title holds

5. Full motion build up series
6. Full motion repeat with titles
7. Hold - Title rotary engine
8. Fade out

Timings for each section were added. The schedule was revised until the best series could be devised.

Following my shooting script, it took eight hours to shoot on the Oxberry animation crane. This is a very painstaking job. It takes a maximum of concentration. If there was one mistake in shooting in the more than 1100 frames shot, the entire animation would have to be shot again from the beginning.

The animation was shot on Eastman Color Original ECO 7252. The exposure was on F/8 with the shutter speed of 110, or 1/10 of a second. The processing and work printing of the film was done by Motion Picture Labs of Memphis, Tennessee.

In animation the proof is viewing the film at normal projection time. One has to see if it was properly planned. . . flows smoothly. . . is not too fast. . . is not too slow. . . movements evenly spaced. . . holds of titles long enough. . . and if all that planning was correct.
CHAPTER V

IDENTIFICATION ANIMATION: THE RIT/TV 2 LOGO

The Animation of the Rochester Institute of Technology Television Center Logo for a 10-second station identification was more of a creative endeavor. The station identification is limited to 10 seconds; therefore the animation had to be simple, but fun to view. It also had a purpose: to get across a message by identifying the station.

My first step was to come up with a storyboard to show the movements I intended to execute. My first attempts were good, but upon analysis I discovered it would take more than the allotted 10 seconds to show the animation. I was forced to cut down the movement and simplify it.

In order for a viewer to read a title on the television screen, it must appear for a good length of time; long enough to read it three times consecutively. My title, RIT/TV 2 had to be on the screen then for at least two and a half to three seconds to be fully effective. This cut my animation time down to seven seconds. With these restrictions, a stationary revolving motion would work the best and convey the message. I used the colored logo on a black field because it usually works better, and does not show
as much dirt since it will be handled a lot at the television center.

Once the storyboard was approved, the mathematical calculations began. No artistic work was done until a shooting script was formulated. Each section of the revolving logo was to start building at different times, but it would finish simultaneously. The calculations for this movement would take 26 cels. I wanted the logo to appear in color with the background in black. There are several ways to achieve this visually. After experimentation and research, I found the best way to have the movement smooth and retain the richest color was to follow these steps.

1. Make a precalculated drawing of the movement the same size as intended for the animation.
2. Take an 11 X 14 Oxberry punched clear cel and cut the total RIT/TV 2 logo out on the cel using two layers of Red Zip-a-Tone.
3. Pre-punch enough 11 X 14 Kodaliths Oxberry standard under red safe lights for the entire sequence (Total of 29).
4. Place punched cel with logo over prepunched Kodalith on an Oxberry peg bar and expose under 150 watt tungsen bulb #212- A focused light source.
5. Develop in Kodalith fine line developer for three minutes. Stop and Fix the Kodalith. After it is developed there is a clear image of the logo on a black background. This is the
finished cel #26 (If two layers of red zip-a-tone are not used the clear image area will have an overall photographic fog.)

6. Using the precalculated movement guide, enough red zip-a-tone from the guide cel was removed allowing cel #25 to be visible. Expose and develop to same as previous cel on 11 X 14 Kodalith.

7. Using the precalculated movement guide, enough red zip-a-tone was removed to expose cel #24. Expose and develop the same as #26 cel on 11 X 14 Kodalith.

8. Using the above method, the remainder of the Kodalith were made for all 26 cels in the sequence.

9. When all 26 cels were made on the Kodaliths the logo still has an overall photographic fog and is not completely transparent. The slight tan overcast dulls the colors to be put on quite a bit. A mixture of Potassium Ferris Cyanide with water carefully applied to the base or emulsion side of the Kodalith will remove the tan overcast. Care must be taken in mixing and applying the solution, as it can eat through and make clear areas not intended to be cleared. The brush used for this step must not contain any metal, as the solution will eat through metal. The use of a Japanese wooden brush is suggested. The Kodaliths
should be taken out of the fixer for this operation and then returned to the fixer for another five minutes. After this operation the fixer tray should be washed out well, and care should be taken to wash one's hands thoroughly also. Potassium-Ferris-Cyanide is very potent and should be used with care.

All the cells for my animation now existed in black and clear. To add the colors Cartoon Colour Cel Vinyl was applied to prepunched Oxberry registered clear acetate cells. By using these clear cells, color could be changed easily just by putting in different punched cells behind the Kodaliths. This allowed me to have a rainbow movement effect without preparing new Kodalith cells for each color needed.

The following shooting script was established:

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<th>Frames</th>
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<th>Action</th>
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<tr>
<td>1-52</td>
<td>52</td>
<td>1-26 Logo on</td>
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<tr>
<td>53-76</td>
<td>76</td>
<td>Hold</td>
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<tr>
<td>77-137</td>
<td>137</td>
<td>Wipe on RIT/TV 2 Logo</td>
</tr>
<tr>
<td>138-162</td>
<td>162</td>
<td>5 color wipe</td>
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<tr>
<td></td>
<td></td>
<td>5 frame each</td>
</tr>
<tr>
<td>163-240</td>
<td>240</td>
<td>Hold</td>
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The film used was Eastman Kodak Ektachrome EF 5242. Testing proved this film to give the richest black and most brilliant colors on a black field.

The film was developed by Motion Picture Labs in Memphis, Tennessee.
CHAPTER VI

CONCLUSION

A graphic communicator today should be aware of the techniques and benefits of the different media. I think it is important to be able to select the best format to communicate a message.

Animation can bring any idea to life, but when working with animation, the idea, no matter how cleverly conceived is sometimes the easiest part of the final result. The cells for the finished projected film should be most carefully planned and each illustration rendered to the maximum of precision. The variables in an animated film are almost incomprehensible. No matter how well I did the pre-production planning, variables still emerged and had to be dealt with.

The Wankel Rotary Engine could be one of the most revolutionary inventions in the automotive industry. To show how the engine works I feel that the best media to use is animation. It can make the theory most comprehensible to the average person. In only 45 seconds, without the use of sound, the viewer receives a general knowledge of how a highly technical and revolutionary concept operates. Upon showing the animation to a group of well educated friends, I received favorable comments as to its educational value. These friends who had read about the Wankel Rotary Engine were still leary
about how it actually functioned. After viewing the animation they came to understand for the first time the basic simplicity and beauty of Felix Wankel's Rotary Engine design.

There have been countless discussions and articles written about the Rotary Engine. I feel this animation is an powerful tool for certain subjects in education and communication.

Here the additional amount of production time is greatly outweighed by the increased educational value of the end results.

To me animation is the most complex of all art forms. It combines precision with art, photography and the concepts of time. My Two Studies in Animation have served as a basic beginning to my understanding of the use of full cell animation in visual communications.
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20
### Rotary Engine Shooting Script

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22
Filmaker 16mm Animation Stand Model 5332

...for the industrial and educational animation producer requiring professional standards.


Muybridge, Eadweard. The Human Figure in Motion. New York: Dover Publications, Inc., 1955.

Renwal Products Co., The Visible Wankel Rotary Engine No. 811. Fairless Hills, Pa.: By the Author, 1 Newbold Road Penn Warner Park.


My thanks to:

Walter Czajkowski: Process Development Engineer/Bausch & Lomb (and Mazda Rotary car owner)

Olena Quill: Facilities Engineer/
Eastman Kodak Company

for their technical advice concerning the animation of the Rotary Engine.