Andrew Reichel
Research Assignment: Maltese Cross

In the film *Kings of the Road*, released in 1976 and directed by Wim Wenders, one character pulls out a chipped projector piece that had previously caused an unsteady projection of a film. He then declares that "Without this little thing there'd be no film industry. It draws the film 24 times a second one frame further on. It converts the torque into a forward movement."[1]The piece in question is most commonly known as the Maltese cross mechanism, a still-frequently used intermittent motion mechanism that was a critical step in the design of film projectors and remained a majorcomponent of most projectors for over a century[2], until the analog era finally came to an end during the transition to digital. Whether this part of the projector specifically ensured the film industry's existence is a more subjective discussion and is most likely an impossible question to answer, but there is no denying that without the previous discovery of intermittent motion mechanisms and their ability to be used for projecting films at specific rates of motion, the film industry's existence would have played out in a very different form.

One of the critical steps in the creation of devices rooted in time-keeping purposes, such as watches and other forms of clockwork, was the creation of intermittent motion mechanisms. Mechanical devices such as sewing machines, assembly machines, or watches require some form of continuous motion in their operation, but they also need to move at a specific and consistent rate that allows for a very slight pause, ensuring a greater form of accuracy in creating stitches, assembling products, and keeping track of the current time of day.The Maltese cross mechanism is an intermittent motion mechanism typically used for these types of devices. It is more commonly known as a Geneva drive outside of film projection circles; both to prevent confusion

[1]*Kings of the Road* (Criterion, 1976).
[2]Leo Enticknap, *Moving Image Technology: From Zoetrope to Digital* (Wallflower Place, 2005), 31, 135–36, 138.

with the design of the civil ensign Maltese flagfrom which it took its name,and because it is generally believed to have originated with Genevan watchmakers.(The design and name of the Maltese cross mechanism has arguably resulted in multiple people confusing the civil ensign flag of Malta that features the shape in question as the country's primary national flag.) Multiple Geneva drives are generally referred to as "Genevas," which is how they will generally be referred to hereafter.

While it is generally agreed that the origins of Genevas come fromengineering innovation in the watchmaking industry, the actual date of its creation for these purposes is likely to remain unknown. It is "one of the earliest of all intermittent motion mechanisms,"[3] andit would go on to be adapted for a variety of different time-based devices, thus making its exact origins difficult to pinpoint for contemporary researchers. Some sources place their creation around the 17th or 18th century[4], but the secrecy surrounding the design methods of Genevan watchmakers around this time[5]and the general amount of time that has passed since then makes it difficult to guarantee that this is an accurateorigin date. However,by the time of the Industrial Revolution, it was alreadya well-known creation that played a critical role in the creation of certain machines that would go on to result in the more mechanized worldthat we are living in today. One could possibly argue that intermittent motion mechanisms resulted in a major shift in humans' perception of time due to their ability to inherently standardize certain units of time passing.

It is easier to point to when the use of Genevas in movie projectors began to play a part in the history of film projection.Their use in film projectors dates back to 1896, when projectors featuring the device weredesigned independently by two Germans, Oskar Messter and Max

---

[3]John Bickford, *Mechanisms for Intermittent Motion* (Krieger Publishing Company, 1972), 127–38, https://ecommons.cornell.edu/bitstream/handle/1813/57662/002_010.pdf?sequence=11&isAllowed=y.
[4]"Geneva Drive," Wikipedia, March 17, 2021, https://en.wikipedia.org/wiki/Geneva_drive.
[5]Victoria Gomelsky, "Cracking the Watch Industry's Code of Silence," *The New York Times*, April 12, 2021, sec. Fashion, https://www.nytimes.com/2021/04/12/fashion/watches-suppliers-secrecy-switzerland.html.

Gliewe, and one Briton, Robert William Paul.[6]Paul was the man who invented the Theatrograph, Britain's first commercial film projector. Messter and Gliewe's discoveries in designing their projectors were made independentlyof one another,and they were unassociated with each other at the time, but Gliewe would go on to work for Messter's company. This would result in Messter going on to overshadow Gliewe in history as the "Father of German Cinema,"[7] to the point where it is easy to find pictures of Messter but pictures of Gliewe do not seem to exist anymore.

Prior to this discovery, previous projectors in the Victorian era had used a larger "beater mechanism" to allow for similarly intermittent motion of the film through the gate of the projector[8], but the Maltese cross mechanism was both smaller and more efficiently designed, thus ensuring that it would be taken up widely for future projector designs, and remaining the default intermittent motion mechanism for nearly the entire analog era of film projection. Since the Geneva, and thus the film's sprockets, were locked into place in front of the projector beam for a fraction of a second before continuing at a consistent rate of movement, it allowed for a steady projection of the static frames on reels of film, thus allowing for the illusion of motion that was what motion pictures were designed for. It also ensured a somewhat lessrisky form of physical interaction between the film itself and the intermittent motion mechanism than the Victorian beater mechanism did. The ultimate contradiction of film projectors, which would continue for the entirety of the analog era of celluloid projectionand still remains an issue today, is that they require some form of interaction with the filmin order to display them, even though their parts are sturdy and hard enough that they can frequently damage the material in the long

[6] "Geneva Drive," Wikipedia, March 17, 2021, https://en.wikipedia.org/wiki/Geneva_drive.
[7]Stephen Herbert, "Who's Who of Victorian Cinema," Who's Who of Victorian Cinema (Stephen Herbert, 1996), https://www.victorian-cinema.net/features.
[8] Ibid.

term. Striking the right balance with this fundamental tension has been a critical part of the design of projectors.

Genevas are used in film projectors to ensure a controlled rate of motion, moving in a way that exposes each individual frame to the light of the projector beam for a set amount of time before the device advances onto the next frame faster than the human eye can process (assuming the goal is a “normal” projection that resembles natural movement, rather than a film that may rely on a deliberately slowed down frame rate to call attention to itself). The default frame rate of 24 frames per second means that Genevas are running at incredibly high speeds that allow for the illusion of images in motion to be seamless, and even a slower frame rate still results in rapid movement of the film through the projector. The most common layout of Genevas consists of two wheels: a rotating drive wheel and a driven wheel. The rotating drive wheel is equipped with a driving pin that enters a slot, also known as a “dwell,” located in the driven wheel. This advances the device by one step at a time, allowing for watches, assembly line products, and film projectors to move at the set rate required for time-based operating systems. The rotating drive wheel also has an elevated circular blocking disc that holds the rotating driven wheel in position between the steps, although the name for this part varies since it is not as important and tends to be associated with fewer of the common issues related to Genevas.

While versions of the Geneva that featured four dwells received the “Maltese cross” name because of their resemblance to the cross on the civil ensign version of the Maltese flag, versions featuringa higher number of dwells becameincreasingly commonfor other devices as they spread in use for a variety of different mechanisms. (Versions with fewer dwells seem to be extremely rare, and would likely be counterintuitive.) Said variationswere actually used in the

original format of the projectors that Messter and Gliewe had independently designed in Germany, along with Paul's Theatrograph design. Their projector designs went fromthe seven dwells initially used in the Theatrograph, to five (called a "star cross"), until finally reaching the commonly used four that remained a mainstay with film projectors from then on thanks to the need for standardization.[9]Genevasalso tend to be made of steel,or other similarly durable metals– they are designed to last for as long as possible within their devices. Befitting their supposed age of origin in the 17th century, they are considered "the simplest and most inexpensive of all intermittent motion mechanisms."[10] However, the possibility of gradual erosion is still a problem for the drive pins, which take all the centralized wear of the rapid motion of the device and can become damaged as a result of wear and tear. (This is most likely the chipped part in *Kings of the Road*.)

Certain manuals dedicated to mechanical devices such as Genevas discuss weak points in the device besides the potential for erosion on the drive pin: "For instance, for each rotation of the Geneva (slotted) gear the drive shaft must make one complete rotation. Thus for very high speeds, the drive shaft may start to vibrate […] the designer has no control over the acceleration the Geneva mechanism will produce [and it] will always go through a small backlash, which stops the slotted gear. This backlash prevents controlled exact motion."[11]This is a potentially problematic feature when dealing with filmsthat are running through a projector at high speeds, which are frequently sufficiently fragile to potentially have issues dealing with this backlash from hard metal parts. This is particularly a concern with acetate film, which tears easily. Film reels tend to have damage concentrated at the start and end, and the issue of the Maltese cross'

[9] Herbert.
[10] Bickford.
[11]Adam Shaver and Matt Semke, "Geneva Mechanism," Mechanics Pages (University of Nebraska-Lincoln), accessed September 24, 2022, http://emweb.unl.edu/Mechanics-Pages/em373honors-S2001/em373/geneva/geneva.htm.

backlash is one of many reasons why this can potentially be the case. There is also the potential problem of their design being set in place: the number of dwells cannot be changed, and that essentially locks the revolution rate and the motion curve in place for the machine. This is not as much of an issue in the field of film projection due to the need for standardization of design components, as there are virtually no functioning projectors in existence that feature a Geneva drive with more or less than four dwells, and those that do possess such a design would most likely be considered obsolete antiques. However, it is a potentially problematic issue for other machines that utilize a Geneva in their respective designs, as a need for a change in the layout of their intermittent motion mechanisms may render the overall designs of the machines totally obsolete, in the same way that projectors with more than four dwells in their Geneva are considered to be.

Genevas come in three forms: internal, external, and spherical. Spherical Genevas are rarely used due to the fact that they need to operate at an angle that takes up more space within their machine[12], and when they are used, they are generally found in assembly machines that have more space to work at a 90-degree angle.[13]Their name comes from the semi-spherical shape of the driven wheel that exists at a right angle to the driving pin. Internal Genevas are generally used for machines that require faster speeds, as they have shorter dwell periods and faster motion periods.[14] Their rotating drive wheels tend to be much smaller and located below the driven wheel. All of these factors make them unsuited for the needs of film projectors. The design of the external Genevaswith four dwell slots arethe ones found in countless analog projectors, and external Genevas are generally the most common form of Geneva drives due to the fact that they

[12] Bickford.
[13] Rajat Dhanvijay, “Free CAD Designs, Files & 3D Models | the GrabCAD Community Library,” Grabcad Community (Stratasys, May 11, 2021), https://grabcad.com/library/spherical-geneva-mechanism-4.
[14] Bickford.

can be built atthe smallestsizes and withstand the most stress, making them the most practical option for most machines requiring an intermittent motion mechanism.If one refers to a Geneva drive in the generic sense of the term, it is most likely to be referring to an external one, and they are the only ones found in film projectors due to the needs of bothstandardization and film stock design. Since peak acceleration and velocity of Genevas is always a function of the number ofdwell slots contained in the device, this results in set motion curves that limits film projectors, and any other device that uses them for intermittent motion, to set rates of operation. This is the key factor thatresulted in the standardization of film projectors featuring Genevas possessing four dwells.

Canadian filmmaker-turned-mathematician/computer scientist-turned-9/11 conspiracy theorist Alexander Keewatin Dewdney would make aseven-minute experimental film in 1967 entitled *The Maltese Cross Movement*:

> "The film reflects Dewdney's conviction that the projector, not the camera, is the filmmaker's true medium. The form and content of the film are shown to derive directly from the mechanical operation of the projector - specifically the Maltese cross movement's animation of the disk and the cross illustrates graphically (pun intended) the projector's essential parts and movements. It also alludes to a dialectic of continuous-discontinuous movements that pervades the apparatus, from its central mechanical operation to the spectator's perception of the film's images... (His) soundtrack demonstrates that what we hear is also built out of continuous-discontinuous 'sub-sets.' The film is organized around the principle that it can only complete itself when enough separate and discontinuous sounds have been stored up to provide the male voice on the soundtrack with the sounds needed to repeat a little girl's poem."[15]

To put it more simply, the film purposefully displays images intermittently, with deliberate gaps and discontinuities in both the image and the soundtrack calling attention to the fact that what we are seeing and hearing is being controlled by the rate of the hypothetical projector that is playing *The Maltese Cross Movement*.(Dewdney also includes numerous shots of an animated Maltese cross going through its rotations in between the "normal" shots of people

[15]Canadian Filmmakers Distribution Centre, "The Maltese Cross Movement," vimeopro.com (Canadian Filmmakers Distribution Centre), accessed December 3, 2022, https://vimeopro.com/cfmdc/maltesecross.

and objects.[16]) Since *The Maltese Cross Movement* is largely seen nowadays via digital copies, the film's stuttering edits play very differently than Dewdney's original artistic intentions, as they are more easily seen as simple manipulations of the imagesand soundtrack in the form of Dewdney's editing rhythms, rather than appearing to be the projector itself stopping and starting as a result of the motion of the titular device. When there is no film projector actually involved, the film's meaning shifts. Whether this shift in formats resulted in a productive new way to interpret the artistic goals of this particular film, or is simply a tragedy of obsolescence, is up to the viewer.

Also of note in the Dewdney film is the fact that it was shot on 16mm film, likely for budgetary reasons. It is also worth noting the fact that shooting on 16mmisits ownform ofartistic convention for experimental films and amateur home movies,arguably because of the lower cost of the film stock(alongside other reasons such as higher levels of grain andwanting to stand apart from more conventional movies shot on larger stocks). Genevas wereused in the film projectors for smaller and cheaperfilm stocks such as 16mm and 8mm film, but not exclusively or predominantly so. This occasionally leads to misconceptions about projectors for smaller film stocks not possessing Genevas as their intermittent motion device, but projectors featuring Genevas for smaller film stocks are still widely available to buyers on the secondhand market.

The Maltese cross mechanism's use in film projectorstends to mostly be discussed in the context of projecting 35mm films (or larger stocks, such as 70mm). This is only partially a question of which film stock was the most commonly seen in most movie theaters during the analog age.Projectors featuring Genevas as their chosen intermittent motion mechanism were a legitimately riskier proposition for the smaller film stocks. The need for smaller sprockets in a physically smaller film would force the film into a tighter loop when it was being run through the

[16]*The Maltese Cross Movement*, Streamed (Canadian Filmmakers Distribution Centre, 1967).

projectors, which put any splice repairs in the film at the risk of being worn away, and thus potentially re-breaking the film as a result. The tighter loops also had a tendency to put more wear onto the sprockets when the projector was running, and thus risked further damage to the film.[17]

Several projectors for smaller gages of film used pawl mechanisms for advancing the sprockets at an intermittent rate instead.[18] These were (and are) also used for projectors that projected larger film gages, and they function similarly to a pair of interlocking gears, or the claw mechanisms in film cameras: the sprockets are briefly engaged as needed for a fraction of a second, and then the mechanism draws back before engaging again with the next frame of the film, allowing the reel to advance intermittently.The aforementioned claw mechanisms from film cameras were also used in a slightly varied form forthe projectors designed for smaller film stocks[19], with a claw reaching into the sprockets, advancing the film by a frame, and then retracting. These involved less consistent engagement between metal parts and fragile film stocks than the more directly engaged Genevas, and were thus a safer proposition for smaller films.

Genevas in film projectors have only fallen into obsolescence in the sense that film projection is becoming an increasingly rare experience nowadays. Where film projectors still exist or are being manufactured, Genevas are still the most commonly used intermittent motion device found in the machinery to advance the film at a set, intermittent rate. Since they are used in so many other mechanisms for different purposes related to set rates of motion, Genevas are

---

[17]J.J. Kotte, "A Professional Cine Projector for 16mm Film," *Perkins Electro-Acoustic Research Laboratory*, December 1954, https://www.pearl-hifi.com/06_Lit_Archive/02_PEARL_Arch/Vol_16/Sec_53/Philips_Tech_Review/PTechReview-16-1954_55-158.pdf.

[18] "Movie Projector," Wikipedia (Wikimedia Foundation, April 23, 2019), https://en.wikipedia.org/wiki/Movie_projector.

[19]Kotte.

still being manufactured in multiple forms and are fairly easy to replace via a custom parts manufacturer. They are also customizable for individual needs, which is practically a necessity given how the three different varieties and many different sizes mean they are usable for anything that needs to be advanced at an intermittent rate of motion. They can even be printed via a 3D printer. The question of how to preserve Genevas in the realm of film projectionthus becomes more of a question of how to properly preserve the projectors used for projection of film.

Most discussion of film preservation tends to focus on the preservation of the films themselves, which is usually justified. Films are notoriously fragile,they exist in abundance, and they can and have been lost forever due to past failures of preservation and the inherent decay that can easily occur with nitrate or acetate film. Film projectors can suffer decay in their own right, but they are sturdy machines that generally last far longer than the films themselves with little to no maintenance. Digital projectors are also more fragile than analog projectors, and they both require more expensive forms of maintenance and frequently need to be replaced altogether when the parts break.

The transition to the digital projection era, however, resulted in the three major theater chains (AMC, Regal, Cinemark) making a deal with the investment groups providing the equipment for the transition to digital: "As far as JPMorganand Blackstone were concerned, as long as 35mm film projection was alive, any rogue independent with a film reel could threaten their investment. In their financing agreements, the investment groups stipulated that all the big three's 35mm film projectors had to be removed or made inoperable…Some projectors were parted out. Most were hauled to the scrapper."[20]This resulted in an incalculable number of film

[20]Will Tavlin, "Digital Rocks," n+1 (n+1 Foundation Inc., March 4, 2022), https://www.nplusonemag.com/issue-42/essays/digital-rocks/.

projectors either being scrapped for parts or destroyed[21] in the years following the smash success of James Cameron's 2009 film*Avatar*, a disastrous failure of preservation that portends ugly possibilities for the future of film preservation if, as per usual, the need for profits gets in the way of things.Swapping from analog to digital projection for the sake of theaters being able to book *Avatar*arguably wound up being a short-term bargain: "Film projectors need only $1,000 to $2,000 per year in maintenance, use easily sourceable mechanical parts, and can last several decades with proper upkeep. Digital projectors require as much as $10,000 per year for maintenance, use proprietary digital parts that can take up to a week to install (during which they're inoperable), and are estimated to last only ten years."[22]

Several independent theaters had the good sense to hold on to their film projectors and several still continue to use them when the opportunity arises to play prints of older films, but this conservation was largely applied to projectors that could play the more standardized film stocks of 35mm and 70mm. 8mm projectors, which were already rarely being used in movie theaters, are an entirely secondhand market nowadays and are no longer being manufactured anywhere in the world. 16mm projectors were more commonly found in somemovie theaters, thus ensuring that there are still theaters in possession of a 16mm projector in working condition. They also have a handful of manufacturers remaining, such as the small distributor Cinemec in Italy[23], but they have also become a market that skews more towards the secondhandand the locally enthusiastic due to 16mm being a more popular format for amateur and experimental filmmakers.

---

[21]"Credit Requirements for Booking Prints (and Photos of Film Equipment Being Junked)," www.film-tech.com (Film-Tech Forum Archive, August 20, 2011), http://www.film-tech.com/cgi-bin/ubb/f5/t002526/p2.html.
[22]Will Tavlin, "Digital Rocks," n+1 (n+1 Foundation Inc., March 4, 2022), https://www.nplusonemag.com/issue-42/essays/digital-rocks/.
[23]"Cinemec," www.cinemec.it (Cinemec), accessed December 3, 2022, http://www.cinemec.it/.

Cinemec is a small operation that should not be confused with fellow Italian film projector manufacturer Cinemeccanica, who are probably the largest remaining manufacturer of 35mm and 70mm projectors[24]. They have never manufactured projectors for smaller gages of film and have largely shifted their operations into manufacturing digital projectors for movie theaters for obvious demand-related reasons, but their projectors during the analog era were and are notable for having Maltese crosses that spun in a counterclockwise direction to advance the film through the gate.[25]Maltese cross mechanisms that spun clockwise were generally the more common direction during the period when film projectors were manufactured regularly, since it is more intuitive for a film that is being generally being projected in an outward-facing direction. However, this is a decision that largely comes down to how the individual manufacturer chose to position individual parts in their design, and was not a particularly critical decision in the history of projection.

Several projectors had the ability to rotate their intermittent motion mechanisms in either direction for rewinding purposes anyway[26], although this inclusion largely comes down to manufacturer preference for the individual design of the projector. One example of this was the Analyst projector, which was designed to run film at variable frame rates and featured a reversing mechanism to allow for films to run in reverse. Since it was predominantly used for 16mm films that had a riskier relationship to their splices due to the potential for breakage[27], the intermittent motion mechanism tended to be in the form of a claw mechanism for these particular

[24]"Cinemeccanica," Cinemeccanica (Cinemeccanica), accessed December 3, 2022, https://www.cinemeccanica.eu/.
[25] "Intramittent Movement," www.film-tech.com (Film-Tech Forum Archive, April 15, 2001), http://www.film-tech.com/cgi-bin/ubb/ultimatebb.cgi?ubb=get_topic;f=1;t=002163#000000.
[26]Ibid
[27]Paul Ivester, "Paul's Basic Guide to 16mm Projectors," www.paulivester.com, 2005, https://www.paulivester.com/films/projector/proj_primer.htm.

projectors[28], thus ensuring that any shifts in frame rates and reversal of the film would involve less interaction. Rewinding a film generallycontains all the risks of projecting a film with none of the benefits.

There is no correlation between the direction of the rotation and the stability of the image quality*per se*, but since the direction of rotation is a function of where certain projector manufacturers choose to locate the individual parts of their designs, this results in some projectors having more stable Genevas and subsequently better quality of projectionthan others do.(This is a hugely subjective field with very little consensus of opinion, especially since the analog era of film projection resulted in countless new projector models being brought out each year, each inevitably coming with their own advocates and detractors.)There are also potentially the factors of the other parts of the machine, some of which may help inensuring that any backlash or jerk when the intermittent motion mechanism stops running is reduced, and thus puts less wear on the film itself. Most films tend to have concentrated damage at the end of each reel as a result of there being a whole host of potential issues when the mechanism runs out of film to run through. Maltese cross mechanisms generally tend to be one of the sturdier parts of a film projector due to being made of steel and other metals of similar durability, but they are also only as good as the other parts in the machine that they have to interact with when they are being used. They are also, of course, dependent on the quality of the film that is being projected. Shrunken or severely damaged film is a problem for any and all film projectors due to the mechanism for the sprockets being designed for a specific sprocket size, and projectors can accelerate problems with the material if they are unable to interact in the way they were designed for.

[28]Kodak, "224-A SERVICE MANUAL," *Olaf's Kino 16mm* (Kodak), accessed December 3, 2022, http://www.olafs-16mm-kino.de/sonstige%20Dateien%20zum%20download/LW224A.pdf.

Returning to the question of preserving film projectors, the fact that film projectors tend to be very durable combined with the fact that they are now considered a largely obsolete technology to the general public places them in an interesting position as far as efforts of preservation go. The people preserving projectors tend to be local enthusiasts and amateurs with a network for materials such as spare parts and the ability to possibly help each other with repairs, which is essentially the only reason 8mm film projection is still alive in certain circles despite 8mm projectors dying out. It has become increasingly important to preserve technical knowledge of how to repair these machines. Internet forums do not contain as much information as one would hope for due to the fact that there was not much crossover between the peak of film projection and the beginning of the Internet age, but communities and technical tips can nevertheless be found online specifically devoted to the preservation and repair of 8mm technology.

Preservation of projectors related to more mainstream stocks, such as 35mm and 70mm, is a somewhat easier task due to the fact that these projectors are still being manufactured, and there is more institutional support remaining for a variety of reasons: directors advocating for the continued use of film, projectors still being manufactured, a wider network for spare parts (including from the manufacturers of these projectors), the fact that certain locations can show film prints as an experience and thus have motivation to keep their 35mm projectors in good shape, and many others. The biggest question mark as far as preservation of projectors goes is16mm, which exists in an odd middle ground where the film stock is still being used and manufactured, but there are a very small number of new projectors actually being created to show 16mm film.Certain brands of projectors for 16mm film remain common and are capable of showing films at a variety of different frame rates, which makes it easier to find spare parts if

something goes wrong or the projector's bulb dies, but it seems increasingly likely that there will inevitably come a point where vintage projectors, despite their fundamental durability, are not enough.

While outdated antique projectors tend to be easy to preserve in some form by simply leaving them in appropriate storage conditions and not handling them in a rough fashion, projectors that are still usable in some capacity exist in a grayer area due to the fact that they generally have an owner that wants to actually use them, along with the fact that they generally take up more physical space than individual reels of film. Hypothetically, spare parts and repairs can ensure that film projectors can last for a long time, so the primary question becomes what to do with a film projector when the person using it no longer needs it, whether due to a movie theater closing down or its owner passing away.(There is also the issue of an increasingly small pool of people who are capable of repairing projectors if something goes wrong.) There is likely to be sufficient demand for the projector if it is still functional to make it practical for someone to acquire and use it, but perhaps a more appropriate approach would be to make a point of preserving it.

With film projection generally being on the verge of extinction in most parts of the world due to the digital projection takeover and the need for short-term profits resulting in countless scrapped analog projectors, the time has probably come for museums and archives to begin treating even functional film projectors as objects that warrant some form of preservation, as the market for film projection has only becomesustainable in certain parts of the world, mostly in more urban areas.There exist a small number of museums with exhibits devoted to old-fashioned film projectors, such as Cine Museum in Seguin, Texas[29] and the Museum of the Moving Image

[29]Todd Boatwright, "Vintage Moviemaking on Display at Texas Museum," spectrumlocalnews.com, April 10, 2022, https://spectrumlocalnews.com/tx/south-texas-el-paso/news/2022/04/08/cine-museum.

in New York City[30], but the fact that most functioning film projectors aregenerally being used by either an individual or an institution leaves preservationists looking to keep film projectors in working order for generations to comein something of a dilemma. Also a potential issue is the sheer bulk of some projectors, with numerousprojectors for larger sizes of film stocks generallyrequiring higher ceilings and a wide variety of supplemental equipment to ensure proper projection of the film.

Nevertheless, in the event that a location that still possesses the capability to project movies on film stockwinds up needing to close down, or some other similar circumstance that results in the projector itself being up for grabs, museums and archives should consider making the investment to acquire the equipment and subsequently maintain it, even if they have no intention of actually using it on a regular basis (although using it is, of course, preferable).In the same way that older films that were once considered disposable products are now considered incredibly important to preserve for a greater sense of film history and as a general cultural archive, keeping the tools alive that were used to show film when it was arguably the dominant art form of the 20th century has become an increasingly important act that may not be receiving its proper due as something that should be prioritized in the wake of the transition to digital. The Maltese cross mechanism is arguably the component of the film projector that will have the easiest time enduring as a general mechanism due to it being perpetuallyneededfor other forms of machinery that require intermittent motion, but its status as the part that arguably made the entire analog film industry possible (according to Wenders' projectionist character)has come to an end. The best one can hope for is to maintain the ones that remain in order to ensure that the

[30]"Behind the Screen," Museum of the Moving Image (Museum of the Moving Image), accessed December 3, 2022, https://movingimage.us/event/behind-the-screen/.

techniques of a century can carry on even with the transition to digital rendering them obsolete in the eyes of many.

Bibliography

Museum of the Moving Image. “Behind the Screen.” Museum of the Moving Image. Accessed December 3, 2022. https://movingimage.us/event/behind-the-screen/. Used for information about exhibition of projectors.

Bickford, John. *Mechanisms for Intermittent Motion*. Krieger Publishing Company, 1972. https://ecommons.cornell.edu/bitstream/handle/1813/57662/002_010.pdf?sequence=11&isAllowed=y. Used as a general guide for the mechanical properties of Maltese Cross mechanisms.

Boatwright, Todd. “Vintage Moviemaking on Display at Texas Museum.” spectrumlocalnews.com, April 10, 2022. https://spectrumlocalnews.com/tx/south-texas-el-paso/news/2022/04/08/cine-museum.Used for information about exhibition of projectors.

Canadian Filmmakers Distribution Centre. “The Maltese Cross Movement.” vimeopro.com. Canadian Filmmakers Distribution Centre. Accessed December 3, 2022. https://vimeopro.com/cfmdc/maltesecross. Thanks to Jesse Brossoit at CFMDC for providing me with a screener.

www.cinemec.it. “Cinemec.” Cinemec. Accessed December 3, 2022. http://www.cinemec.it/.

Cinemeccanica. “Cinemeccanica.” Cinemeccanica. Accessed December 3, 2022. https://www.cinemeccanica.eu/.

www.film-tech.com. “Credit Requirements for Booking Prints (and Photos of Film Equipment Being Junked).” Film-Tech Forum Archive, August 20, 2011. http://www.film-tech.com/cgi-bin/ubb/f5/t002526/p2.html. For information and photos of the destruction of projectors.

Dhanvijay, Rajat. “Free CAD Designs, Files & 3D Models | the GrabCAD Community Library.” Grabcad Community. Stratasys, May 11, 2021. https://grabcad.com/library/spherical-geneva-mechanism-4. Used for some further information about the rarer spherical Genevas.

Enticknap, Leo. *Moving Image Technology: From Zoetrope to Digital*. Wallflower Place, 2005. Used as a general overview for projector technology.

Wikipedia. “Geneva Drive,” March 17, 2021. https://en.wikipedia.org/wiki/Geneva_drive. Used as a general overview for some basic facts about Genevas.

Gomelsky, Victoria. “Cracking the Watch Industry’s Code of Silence.” *The New York Times*, April 12, 2021, sec. Fashion. https://www.nytimes.com/2021/04/12/fashion/watches-suppliers-secrecy-switzerland.html. Used as a resource regarding the secrecy of the Swiss watch industry.

Herbert, Stephen. “Who’s Who of Victorian Cinema.” Who’s Who of Victorian Cinema. Stephen Herbert, 1996. https://www.victorian-cinema.net/features. Used as a resource for Victorian cinema information.

www.film-tech.com. “Intramittent Movement.” Film-Tech Forum Archive, April 15, 2001. http://www.film-tech.com/cgi-bin/ubb/ultimatebb.cgi?ubb=get_topic;f=1;t=002163#000000. Provided information about the direction of rotation for Maltese crosses in certain projectors.

Ivester, Paul. “Paul’s Basic Guide to 16mm Projectors.” www.paulivester.com, 2005. https://www.paulivester.com/films/projector/proj_primer.htm. Used for information about the needs of 16mm projectors.

Kings of the Road. Criterion, 1976. Used the clip we were shown in class.

Kodak. “224-A SERVICE MANUAL.” *Olaf’s Kino 16mm*. Kodak. Accessed December 3, 2022. http://www.olafs-16mm-kino.de/sonstige%20Dateien%20zum%20download/LW224A.pdf. Used for guidance regarding the parts of an Analyst projector.

Kotte, J.J. “A Professional Cine Projector for 16mm Film.” *Perkins Electro-Acoustic Research Laboratory*, December 1954. https://www.pearl-hifi.com/06_Lit_Archive/02_PEARL_Arch/Vol_16/Sec_53/Philips_Tech_Review/PTech Review-16-1954_55-158.pdf. Used for information as to why 16mm projectors frequently did not have Maltese cross mechanisms.

Wikipedia. “Movie Projector.” Wikimedia Foundation, April 23, 2019. https://en.wikipedia.org/wiki/Movie_projector. Used for basic information about projectors in general, along with pawl/claw mechanisms being used for smaller film stocks.

Shaver, Adam, and Matt Semke. “Geneva Mechanism.” Mechanics Pages. University of Nebraska-Lincoln. Accessed September 24, 2022. http://emweb.unl.edu/Mechanics-

Pages/em373honors-S2001/em373/geneva/geneva.htm. Used for information about the potential faults of the Geneva.

Tavlin, Will. “Digital Rocks.” n+1. n+1 Foundation Inc., March 4, 2022. https://www.nplusonemag.com/issue-42/essays/digital-rocks/. Used as a resource about Hollywood’s transition from celluloid to digital.

The Maltese Cross Movement. Streamed. Canadian Filmmakers Distribution Centre, 1967. Thanks again to the CFMDC.