THE MECHANICS OF JEWELRY
SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE
MASTER OF ARTS
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MUNCIE, INDIANA
JULY 2011
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Statement of Problem

There are three major questions and obstacles that I will deal with in the creation of my art. The first question, “how do I incorporate industrialized objects such as screws and gears into jewelry?” comes from my love of mechanical objects that are parts of a larger whole. With my second question, “how can I make these industrialized objects out of precious metals, primarily silver?” I attempt to meld industrial parts with precious materials. The third question is, “how can I incorporate gemstones into these objects?” Many of the gemstones that I will be using in my work are rather large in comparison to mainstream jewelry. The successful integration of these large gemstones will be critical to the design and aesthetic appearance of some of my work; the success of the rest of my work will be contingent on the integrated mechanics, specifically gears.
Influences

My initial influence was that of the Steampunk Genre, which was influenced by the mechanics of the Industrial Revolution. Steampunk is a genre of literature and art set in the Victorian era where steam is the predominant power supply. The Steampunk technology is heavily influenced by mechanics and what tends to be over-engineering of items. “The Corkscrew”, by contemporary artist Robert Higgs, is a very good example of this type of over-engineering. A very complex piece of machinery that consists of multiple gears, pulleys, levers, clamps, springs, weights and counter balances was made to perform the very simple task of uncorking a bottle and pouring a glass of wine. (Bull)

My designs were heavily influenced by the book 507 Mechanical Movements by Donald T. Brown. This book illustrates the design and mechanics of very functional and technical movements found in industrial revolution era machinery. I used these mechanical diagrams as the basic influences for my designs. I looked at the beauty of the movements and gears themselves, instead of concentrating on the function that they would normally
serve in a piece of machinery. The body of work focused on bringing the mechanical elements and the technical elements of fabrication to the forefront of the design as the center of attention.

I researched contemporary artists who have incorporated mechanical elements into their work as well as jewelry techniques prevalent among older European jewelers. These European jewelers, especially early to mid 20th century artists, used a very methodical and technical approach to their art. Prime examples are European modernist jewelers such as Friedrich Becker from the 1950s, and Abrasha who still continues to work.

The Steampunk Genre

The Steampunk genre began as a literary movement with Jules Verne and H.G. Wells. As the literature style of these two writers influenced others, the genre eventually evolved, expanded, and morphed into the broad and expansive world of Steampunk culture and literature that exists today. The beginnings of the mechanical aspects of Steampunk are epitomized in the mechanical inventions created by Jules Verne’s 20,000 Leagues Under the Sea, specifically the Nautilus, Captain Nemo’s submarine. The Nautilus was an engineering marvel that Jules Verne created in great detail and description. “The Nautilus is composed of two hulls, one inside, the other outside, joined by T-shaped irons, which render it very strong. Indeed, owing to this cellular arrangement it resists like a block, as if it were solid. Its sides cannot yield; it coheres spontaneously, and not by the closeness of its rivets; and its perfect union of the materials enables it to defy the roughest seas.” (Verne, 62) This is just a small
This attention to detail and mechanical invention are the roots of the Steampunk genre.

The modern Steampunk literature movement began with three authors in the mid-1980s, Tim Powers, K.W. Jeter and James Blaylock. In their books, “All three authors…were writing a form of alternative history based in Victorian times…Blaylock, Jeter and Powers created excellent adventures and mystery narrative, often with a social emphasis, a focus on clockwork/steam technologies, and a definite awareness of Verne and Wells.” (Vandermeer, 49) Fanciful technology, steam powered vehicles and airships, Victorian style dress, clocks and mechanical marvels all took their place in the creation of this alternate history. The genre has splintered to form sub-genres as well; Clockpunk is where, “Clockwork technologies replace or supersede traditional steam power.” (Vandermeer, 54) This sub-genre has an appreciation and dedication to the mechanized components of a clock, the gears specifically; this is where my major influence can be found.

The clock and watch are defining technological and mechanical creations. Every gear, balance wheel, spring, screw, rivet and plate is necessary for the function of a timepiece. The machining and precision of each component are vital in the accuracy of the piece. My work follows a very mechanical, planned, and thought out step-by-step process in every piece that I create. You cannot skip steps or leave out components. Every measurement, every cut, every piece of metal is critical to the overall design and function of the jewelry I create.

While I do not go into great detail in my work, as did Verne in his description of the *Nautilus*, I focus on the basic element of a clock, its gears; I have taken a rather complex item and mechanism, and simplified it to its base component. I use the shape of the gear as a
major design element. I also use gears, one with another, to create movement and cohesiveness within each piece. The gears become the center of the pieces, both in design and in functionality, in the second segment of my work.

### 507 Mechanical Movements

The discovery of Donald T. Brown’s 507 Mechanical Movements was a defining moment in the influence of my work. Donald T. Brown first published this book in 1868, one year before Jules Verne’s 20,000 Leagues Under the Sea was published, because of “The want of a comprehensive collection of illustrations and descriptions of Mechanical Movements has long been seriously felt by artisans, inventors and students of the mechanical arts.” (Brown, Preface) The book diagrams and explains the use and mechanics of 507 different movements, their common use, and function. The movements are varied in their design, function and mechanical composition. While some movements rely on the integration of various gears, others rely on ropes and pulleys. One movement might be the integral piece of a watch, while another is part of a large piece of farming machinery. The size, function and purpose of each movement were insignificant to my research. I viewed the mechanical diagrams as a sketch book of ideas.

I focused on the integrated relationship of the movements, the spur gears, linear gears, rotary gears and adjoining elements that are all necessary for the piece to function, and break
them down to an even more simplified form. I looked at the different diagrams and analyzed and decided which elements I could remove, and turn into an aesthetically pleasing piece of jewelry. Two gears from a very complex movement can be isolated and transformed into a piece of jewelry that still maintains the mechanical aspect of movement between the two gears. 507 Mechanical Movements became a sketch book and source of inspiration for this body of work.

**Friedrich Becker**

Friedrich Becker, who was born in 1922 and died in 1997, is just one of many great German jewelers who are known for their mechanical and technical prowess. Friedrich Becker was trained as a mechanic and engineer. This mechanical influence is obvious in his work. He is one of the first jewelers to incorporate kinetics into his work. Many of his pieces were designed with moving parts that were engaged as the wearer moved. His work was constructed so that the mechanical movements were internal and hidden from sight; one would not know that the piece had moving parts until it was picked up and moved.

Friedrich Becker was also known for his geometric shapes and objects. The designs are all very clean and fluid. The combinations of unadorned design as well as the kinetic movement of his pieces were influential in my own work. As I examined the mechanical movements from Donald T. Brown’s book, I would often simplify the overall nature of the
piece. Friedrich Becker’s work showed that one could create very complex mechanical objects while maintaining a very clean and pure look. During the 1950’s Becker designed and developed pieces that had interchangeable gemstone cabochons; “The emphasis was not on the piece of jewellery as an ornament but as a construction…” (Arnold, 19) The idea of a construction and a fabrication were very influential in my train of thought and work.

**Abrasha**

Abrasha is another German Jeweler/Artist whose most well known work has been completed in the last twenty years. Abrasha’s work was a huge source of inspiration to the design and fabrication process of my own work. Abrasha “attended the "Goldschmiedeschule" (School for Goldsmithing) in Pforzheim, West-Germany” for two years, and then studied with Klaus Ullrich, a leading German Jeweler/Artist at the time, for one year. Abrasha gave the following insight about Ullrich and his own design inspiration, “I was strongly influenced by his work, both in design and technique. Other influences on my sense of design have been: the Bauhaus movement and Japanese design, which both share a strong sense of simplicity.” (Abrasha)

On his web site, Abrasha gives a closer look to his inspirations, work and process. In his Artist Statement he makes the following two comments:

My work is contemporary, geometric and simple in style and feeling. I am a purist when it comes to the choice of my materials. I use high karat gold alloys (which I make myself), platinum, silver and fine gems, but also unconventional materials like found objects such as discarded CO2 cartridges or pachinko balls, stainless or rusted...
steel and plywood. My work is hand-fabricated. I usually combine two or three different materials to create tension between them and their colors, in my designs.

I like to integrate design and technique, especially when I use rivets. They are not only functional in that they often actually hold the pieces together, but have also become an important visual design element. They are often slightly irregular in shape and location which contrasts with the strong geometry of the rest of the designs.

(Abrasha)

His “purist” ideals in relationship to metal usage, pure design, the use of multiple metals “to create tension” and the use of rivets all had a major influence on my present body of work. His design process was also something that resonated with my own. After a design is finalized, he would make technical diagrams to further guide him to completion of his projects. The manufacturing of Abrasha’s Pachinko ball Bracelet is examined in great detail on his website and offers a great insight to his work process.

Abrasha’s pieces are elegant and clean in design, but have a very technical step-by-step, part-by-part method of fabrication. Abrasha has in-depth documentation of the step-by-step process of fabricating a few of his pieces. I was able to take a lot of inspiration and information from these documentations. The repetitive element of constructing identical
parts is very similar to that of commercial manufacturing. The use of identical parts was important in my own work, and it was beneficial to see how another jeweler/artist approaches this task. Abrasha’s use of rivets to hold his pieces together was inspirational to my own use of miniature nuts and bolts, as well as to my use of rivets in certain projects.

The Steampunk genre influenced the path that I wanted to take, one of industrialization and mechanical jewelry, and influenced my overall design. 507 Mechanical Movements was a major design influence, and gave me more designs than I had time to complete. Friedrich Becker was an inspiration in his simple design and in his use of hidden mechanical kinetics. Abrasha’s work, however, offered more inspiration for my own design and fabrication methods than any other source. His mastery over the metals that he used fueled my desire for exactness, precision and detail. His designs and fabrication methods pushed me past the desire to merely create, but inspired me to learn as I created. It showed me the need to branch out and to use design elements, tools and materials in my work that I probably would not have thought about using otherwise.
Description of Artworks and Process

This body of work can be separated into two segments. In the first segment, I focused on fabrication and the integration of large gem stones in the jewelry pieces. Heavy emphasis of construction and aesthetics, similar to the work of Abrasha, was used to create these works. The second segment has more influence from the Steampunk genre and Fredrich Becker. There is a major emphasis on functional gears and movement/kinetics. The second segment of work still relies on the elements of construction and fabrication learned from the first segment.

Segment 1: Fabrication and Integration

I created a piece several years ago that relied on tension, to set two fluorite octahedrons; one octahedron was set in a ring, and the other was set in a pendant. I used this idea of tension as inspiration in setting the large gemstones that I used in my pieces. I found that the use of tension enabled me to successfully integrate the stones into the designs of the piece, giving the overall design a more fluid and natural look by avoiding large prongs or other techniques in securing the stone; but at the same time, it did not force me to compromise the security of the stone.
With the first piece that I created, I wanted to replicate the design of the fluorite pendant by using an outer rim and four supports to hold the stone. The stone, a 23.5 carat princess cut mystic topaz, seemed like an ideal candidate for this design since I could use the four sides of the stone and a support system to create tension to the stone in place. I wanted to use an industrial element as the supports, and determined that I could create nuts and bolts to hold the stone in place through an increasing amount of tension as the nuts were tightened. I used a tap and dye set to thread silver rod, creating screws, and thick silver discs that were converted into nuts. I created V shaped channels out of silver sheet that were soldered to the ends of the silver screws; the V shaped channels mimicked the edge of the stone, and cradled the stones four edges. I replicated the nuts and bolts to create a bail through which I fit a chain.

Though I used the nuts and bolts to create tension in the first piece, which is a unique way to set a stone, I still relied on the V shaped notches to hold the stone in place. With the second piece I created, I wanted to rely more on the actual structure of the piece as a way to “set” the stone. The complete integration of fabricated pieces of silver, nuts and bolts and a gemstone were my goal. I chose a 34.25 carat diamond shaped pink topaz as my next stone. I wanted to build a structure around the stone. In traditional stone setting, you need two points of contact to secure a stone. Considering that this stone had four points, it was logical that I could use those four points as my points of contact. If I could line up four holes on a plane,
and place the points of the stone within each of these holes, I knew that I should be able to create the tension necessary to secure the stone.

The first step was to create a frame. I would not be able to make the frame out of one piece, because it would be impossible to place the stone within such a frame. I created a frame out of four pieces of silver and found miniature 22k gold plated nuts and bolts that I used to pull the four pieces together. As I tightened the nuts and bolts, the silver frame compressed together to hold the stone in place. I finished the design by attaching a U shaped piece of silver to the frame, with the same nuts and bolts, as a shank for a ring.

I had successfully constructed a piece of jewelry using this fabricated method and four points of contact, and now wanted to push the design even farther, by using just two points of contact. The shape of the stone was critical for this idea to work, and I chose a 21.20 carat briolette shaped citrine that is cut in a way that it only has two points. This piece was created using the same concept as the previous piece; I just needed a frame, and two holes on the same plane to use as my points of contact. The frame was fabricated from four pieces of silver and it was all brought together with the miniature nuts and bolts. The piece was then suspended on a commercial multi-strand cable necklace.
I really enjoyed the concept and fabrication of the previous piece, and wanted to create a matching ring. I used a 13.05 carat briolette cut citrine that closely matched the size and color of the pendant. I used a similar idea, but I pushed the concept of the frame a little farther by cutting slits in two of the four sides of the frame that the other two sides would fit through. The piece was once again brought together with the miniature nuts and bolts. A U shaped piece of silver was used to create the shank of the ring.

Unlike the previous three designs, where the pieces could be completely taken apart and reassembled, this piece could not. It was discovered that by creating the slits in the frame, when the other pieces of the frame were assembled and bent, the frame lost its ability to be taken apart without endangering the points of the stone. While I feel that the overall design of the ring was successful, I also feel that it lost the unique quality of being able to be taken apart and reassembled again. Granted, the ring lost that function, but it also gained more stability. If the screws were all removed from the piece, the stone would still stay in place, it would be loose, but it would not fall out of the frame; the same could not be said for the previous designs. Therefore, the tradeoff was function over stability.

In the next piece, I attempted to combine the concept of the first and third pieces. I wanted to set a large stone with two points of contact with the created silver nuts and bolts, but also use the small 22k commercial nuts and bolts to connect the elements of the piece. I
chose a 41.30 octagon shaped citrine as the stone to create a design around. Like the first piece, I created an exterior rim, though this time I copied the octagon shape of the stone. I used the same method of soldering two V shaped pieces of metal to the ends of the threaded bolts to cradle and hold the stone in place. I used commercial nuts for the piece, as I found they better complemented the color of the stone and the miniature nuts and bolts than did silver nuts. As I tightened the nuts, creating the needed tension to hold the stone in place, I found that the tension did indeed hold the stone in place, but there was an element of instability due to the size of the stone as it wanted to rock back and forth within the frame. I created two elements with a similar V shaped notch to act as stabilizers for the stone. They only act as stabilizers though; they do not create any sense of tension to keep the stone in place. I finished the piece by adding a pin wire on the back so that the piece could be worn as a brooch.

I had employed very geometric design principles up until this point, and wanted to make a piece that stood apart from these concepts, but still contained the elements of tension and fabrication that had been used in the previous pieces. I chose a 15.38 carat briolette citrine as the gemstone since it allowed me to push the design elements while only having to
focus on two points of contact to set the stone. I maintained an element of symmetry in the design by mirroring curves from one side of the pendant to the other and positioned the citrine in the middle of the piece. The fabricated silver elements acted as a cage, holding the citrine in place, though the two points of contact functioned as the major components in setting the stone. This piece is drastically different from the others in the series in the aspects of design and the stone was more challenging to set than initially anticipated. The mirrored elements were more difficult to control and form than the linear elements of the other fabricated pieces in the series; this caused some slight variations in the alignment and construction of the pieces that made the setting of the stone more difficult than in the other pieces.

Segment 2: Gears and Motion

The second segment of work looks to the gear and industrial parts as its major components. I focused on the shape of the gear and the relationship one gear can have with another to create movement as the main emphasis of design with this body of work. 

507 Mechanical Movements was referenced for gear configurations as part of the design process, and the movement diagrams can all be viewed in Appendix B. In some of the pieces, I used more traditional jewelry fabrication methods such as rivets and hinges in lieu of the miniature nuts and bolts.

I decided to use a five gear configuration as the basic design for the first piece that I would create. I choose this configuration because of its simple nature, but also for its ability
to show the integration and movement between all of the gears when one gear is turned. The actual fabrication of the gears turned out to be the most difficult aspect of this piece. I debated over the following methods to make the gears:

1) Hand pierce the gears out of flat stock.

2) Build a 3D gear using CAD software and have a wax model made. That model could be cast in metal, a mold could be made, and multiples could be made from the mold.

3) Cut the gears from gear stock, a long rod that has the outside shape of a gear.

Consistency was my main concern. If I was going to use the gears as mere decoration, the size consistency would not have been important, but since I needed the gears to interrelate one with another, this precision was critical. With hand piercing and casting, the teeth would need to be filed and smoothed, I felt that this would add too much variation since I would not be able to file every gear the exact same way which could make some teeth a little thick and others too thin. Because of this, I decided against hand piercing and casting the gears since the gear teeth consistency could vary more than I thought it would with the gear stock.

After I decided to use gear stock, and was able to procure some from a manufacturing company, I undertook the task of slicing it to make my gears. This turned out to be more difficult than I had originally anticipated. It turned out that I sacrificed consistency with the gear teeth, with that of gear thickness. The gear teeth, however, were the more critical aspect of the gear, and I was also able to devise a way to sand down the gears to a consistent
thickness. Appendix A shows the various methods that I used in trying to get the gears cut to a consistent width and the full process used in making each gear.

I have used 3D modeling software, Rhino, as a part of my design process for years, and saw no reason not to use it as a part of this body of work as well. Previously, I have used the software to create models that I would have milled with a CNC milling machine or printed on a 3D printer to be used as the master model for my work. With this body of work however, the hand fabrication of each piece was important to the overall process and look of the pieces. I planned on using the software as an added design tool. The pieces that I had in mind were all going to need very precise and exact measurements to ensure that all of the gears would function one with another. I used the software as a way to test different configurations, and to give me an accurate idea of what a finished piece would look like. Furthermore, after a piece was designed on the computer, I was able to determine the exact measurements that would be needed for the piece.

At this point I was able to begin with my first piece. As I mentioned, I chose a simple five gear configuration; diagram #222 (Brown, 56) and #412 (Brown, 100) were the main inspirations for this piece. In line with the simple configuration, I designed a pendant that would act as a frame and means of holding the gears together so that the emphasis would remain on the gears and their ability to move. I sandwiched the five gears between two square pieces of silver that had two triangular shaped cutouts that would reveal the gears and their movement. I held the pieces together with 22k gold plated miniature nuts and bolts and added a u shaped piece of silver at the top that a cord or chain could fit through. The initial
sketch, computer render, and measurement diagram of the 5 gear pendant that I created can be found in Appendix C.

When I first tightened all of the nuts and bolts I found that it created a lot of surface tension between the gears and the silver squares. I was able to reduce this surface tension by adding small 22k gold plated washers between the gears and silver. Even with this reduction, I found that gears were difficult to move if they nuts were too tight. In addition to that, the movement of the gears had the tendency to loosen the nuts and bolts. The nuts and bolts were eventually tightened to a desired level and Loctite, an industrial strength thread locking adhesive, was added to keep the nuts and bolts from further loosening. I finished the piece by adding an industrial looking engine turned pattern to the silver pieces.

My intent was to use an even simpler gear configuration with the next piece by only using two gears. The basic design was inspired by diagram #24 of two spur gears, (Brown, 12) and to a lesser degree diagram #55 (Brown, 18) I used a medium and small size gear to construct a ring where the smaller gear would have approximately a 270 degree radius of movement around the larger gear. A silver band was constructed as the main body of the ring. I cut out a silver disc and soldered a small piece of wire into the disc to act as a stop for the center gear, to prevent it from moving. A strip of metal was placed above and
below the two gears and they were connected with miniature nuts and bolts. The entire gear configuration was then attached to the metal band using miniature nuts and bolts. The bolts were trimmed, and Loctite was applied to prevent the nuts and bolts from further loosening. The emphasis of this piece is on the two gears and the movement between them.

The shape of the gears had been as much as an inspiration to me as the movement of the gears. The next piece that I created focused solely on the shape of the gear. The original design for the next piece called for the hand piercing of two large gears out of silver that could be offset and connected with rods to create a bangle. I started with a round piece of silver and measured out the length and depth of the teeth around the circle. Each side of the square teeth was cut first with the idea of cutting out the small square left between each tooth. After I had cut the two sides of the teeth, I decided to bend the small squares at a 90 degree angle to the rest of the bangle and I could then connect these small squares to the small squares of the other half of the bangle eliminating the need for connecting rods. The two halves were cut, the small squares bent, the teeth were slightly rounded, and the two halves were fit together. A small strip of silver was placed in the gap formed by the angled squares and holes were drilled in those squares as well as the strip of silver. The two halves and the strip of silver were then connected with 22k gold plated miniature nuts and bolts. At this point, the bangle was cut in half so that a hinge and clasp could be added. The hinge, and part of the clasp component, was constructed out of hand
fabricated silver. The hinge was held together with a silver rivet. The clasp consisted of a piece of tubing and another strip of silver that had a small bend in it that latches around the curvature of the tubing. The silver tubing was hand fabricated and the following formula was used to determine the size blank I would need in order to make the tubing: Blank size = Outside diameter - metal thickness x Pi x 1.15 (Revere, 204) A sandblasted finish was applied to the inside and underside of the bangle. A high polish was applied to the center strip of silver and the engine turned finish was applied to the outside of the gears.

Victorian era jewelry was very ornate and feminine. Since the Steampunk genre has a very heavy influence from the Victorian era, I decided to push these elements of adornment and femininity in the next project. Victorian style necklaces have a V shaped form where the necklace draped around the back of the neck in thin delicate strands towards the front of the body ending with a dramatic and elegant focal point that forms the shape of a V (See Appendix D). I determined that if I was able to configure three of my five gear pendants together, I could form this V shape.

I started by constructing three of my five gear pendants in the same manner that I had used to make the original one. Due to the repetition of the work, and the fact that I had previously made one, I was able to make the three in about the same time it took me to make the original. I cut small pieces of silver that were connected to the three pendants with the 22k gold plated nuts and bolts; these connections hold the piece in place and give it the V shape that I was after.

I formed four U shaped pieces of silver that I attached to the ends of the necklace as a means of connecting the wire strands that would make up the chain part of the necklace.
used six strands of commercial cable to make the necklace. Three strands were combined with a small piece of tubing at the end. The wires fit through a small hole drilled into the U shaped pieces of silver and the piece of tubing acts as a stop to hold the strands in place. Three strands of cable where fit through all four connectors. I slid small pieces of tubing down the six strands to bring them together near the connectors, further emphasizing the V shape of the necklace. Additional pieces of tubing were slid down the cables to keep them bundled closer together and to add additional detail. The six cables were capped off with a piece of tubing at the ends.

The clasp of this necklace was inspired by the medieval torture device known as stocks. Stocks were a device used for torture and public humiliation where the victim’s arms and head were fit through two or three small holes that were created by two hinged boards. The boards prevented the individual from moving. I decided to make a clasp that used this same principle. I riveted three pieces of silver together and left a small cut out on all three pieces that the cables could fit through. I then created a closure out of wire that would hold the pieces closed during wear. When the cables were fit through the openings and the hinge was closed, the capped ends become trapped, as if they were in the stocks, and the cables are held together at the back of the neck.
The Victorian Gear necklace was the most technical and difficult piece to create, up until this point in, my present body of work. I wanted to end the creative project with something even more challenging. All of my pieces have a heavy emphasis on fabrication, and the gear series has an emphasis on movement, but none of the pieces had any functional aspect to them. I wanted to design a piece of jewelry that incorporated functional gears for more than just movement and design. I wanted to create a piece of jewelry that would open and close by the use of the gears.

I immediately went to 507 Mechanical Movements for design ideas. I chose diagram #92 (Brown, 26), #113 (Brown, 32), #127 (Brown, 34) and #197 (Brown, 50) as possible movements that would allow me to open and close the mechanism I had in mind. My initial design idea was to cut a domed piece of silver into two halves and incorporate a movement that involved gears which would separate the two halves to reveal the inside. I knew that the measurements and precision of this piece would have to be exact if it was to work properly. I knew the basic concept of the piece but I further refined the design as I worked it out with my 3D software. I felt that diagram #197 would be the best movement for this piece, but with a few modifications. I wanted to use three gears, one of my smaller ones that would be attached to a shaft and act as a key, and two of the medium gears that would flank either side of the center gear. As the center gear was turned, the other two medium gears would move small pegs that would be attached to the domed halves on one side and a straight track on the other end; this would cause the two halves to open apart.

I cut out a 46mm silver disc to use as the base of my piece and cut out an 11mm circle in the center; this center hole is where the gear key would be inserted into the back of the
A small strip of silver was soldered around two sides of the center hole and another small silver disc was soldered to these strips of silver. This disc was to act as a stop when the gear key was inserted, allowing it to line up accurately with the other gears. The tracks for the pegs were cut from this disc. Holes for the two medium gears were drilled and the gears were riveted to the base disc.

A large silver disc was cut out and domed using a steel dapping block. I trimmed the dome so that it had an outside rim that measured 46mm in diameter and I then cut the dome in half. A small amount of metal was lost on the edge of the two dome halves when they were cut apart and sanded. Small strips of bronze were soldered to the edge of the domes to close the gap that was left between the two halves. Another 46mm silver disc was made, a 32mm circle was cut out of the center and then it was cut in half. I soldered the bases and dome halves together. The bases added more stability to the domed halves. I took a small strip of silver and soldered four 1.15mm wires exactly 3.1mm apart on this strip of silver. These wires would act as the pegs that would move the domed halves apart. The domes were measured and small holes were drilled so that the wires would pass through the dome. The dome and base were then riveted together by hammering down the wire pegs. Another small strip of silver and two pegs were added to the other side of the dome across from the gear to give the dome two
tracks to slide on, adding more stability to the piece. This process was repeated for the other dome half.

Four open square shapes were soldered to the back of the base. A cord was fit through one of these squares, and the others were there for balance and stability. The small gear was soldered to a silver cylinder to form the gear key. A small rectangular box was fabricated out of sterling silver in which the gear key could be stored. The box was constructed with hinged doors that would open to reveal the key. A cord was attached to this box so that the key and domed pendant could both be worn as separate pieces.

The domed pendant and gear key necklace were the most challenging pieces completed for this project. They pushed my technical and mechanical understanding, as well as my skills as a jeweler, farther than any piece I have ever created. It was a learning experience from start to finish. I feel that it was a very successful way to complete this body of work.
Conclusion

I approached this body of work with the following three questions that I wanted to answer:

1) “How do I incorporate industrialized objects such as screws and gears into jewelry?”

2) “How can I make these industrialized objects out of precious metals, primarily silver?”

3) “How can I incorporate gemstones into these objects?”

The use of industrial objects is not something new within the jewelry industry. Many designers have used these objects as accents in rings, necklaces and pendants. In answering the first question, I did not want to use these objects as mere decoration, but I wanted to functionally integrate them into the designs and pieces themselves. The miniature nuts and bolts that were used throughout the body of work served both functional and decorative purposes. The constructed rings and pendants are held together by the use of those nuts and bolts. The gemstones used are held in place because of the tension caused because of the nuts and bolts. I was successful in ensuring that each part, in any given design, was necessary and purposeful, not merely for decoration.
The gears were used in a variety of ways. First, I was able to use them as an added element of design. The gears in the Five Gear Pendant and Gear ring serve a purpose of design and in adding movement to the piece; the gears however, have no other functional purpose. With the Domed gear pendant, the gears played a crucial role in the functionality of the piece. If it was not for these gears, the piece would not open and close. The shape of the gear was the inspiration behind the Gear bangle. The shape, design potential, and function of the gear were all used to varying degrees.

Finish was also a crucial element to giving my pieces an industrialized look and feel. Most jewelry will have a high polish finish applied to the surface of the metal. I found that these types of finishes did not work with the theme of my work. I did apply a high polish to the briolette citrine ring, but this was done more to reflect the color of the stone than for design purposes. I found that more industrial finishes better complimented my work. I used a brush wire and sandblasted finish with a few of my pieces, but found that my modified imitation of an engine turned finish, used on the Victorian Gear Necklace, was most successful.

In answering the second question, I found that the procurement, or fabrication, of these industrial objects was just as important as the design process. I was able to find suppliers of miniature nuts and bolts and rods of gear stock; these suppliers were essential for the body of work created. If I had not found these suppliers, the constructed gemstone rings and gear pieces would not have been possible, as presently created, in the time frame that was available to me. I was able to make my own nuts and bolts for the Mystic Topaz Pendant, but to make my own on the small scale that was necessary for the other pieces
would have been very time consuming. The exactness that comes from machined parts would also have been very difficult, if not impossible, to replicate. I believe that the purchased parts were a very successful solution to this question. The exactness for my designs benefited from the machined parts, but they also added color and contrast to the work.

The incorporation of gemstones was an integral part to the first half of my work. The stones used in each piece were critical to the design of the piece. Each stone made the measurements and hand fabrication of each piece vital; the measurements were critical to ensure that the gemstones were secure in the piece and in minimizing potential damage to the stones. I used the basic principles of stone setting, but I deviated from normal stone setting techniques. I pushed the process of each new piece to a different level. I was able to incorporate the gemstones as an element of adornment, but also as an important element of the fabricated piece. For example, the citrine in the Octagon Brooch is the focal point of the piece, but it also played a critical role in the overall shape of the brooch and it pulls all of the elements together.

Though I have been trained as a commercial bench jeweler, I attempted to approach my work with a more technical and precise mind frame, similar to how an engineer would approach their work. This body of work pushed my technical skills and talents as a jeweler. I was forced to be very exact and precise in my work. I stepped out of the realm of jewelry and explored that of mechanics and motion. My commercial training gave me the basic knowledge that I needed such as soldering, piercing, and the principles of stone setting that were a necessary foundation, but the German Jewelers Friedrich Becker and Abrasha
inspired me to view jewelry as more of an artistic expression of mechanics. This artistic expression is what I have referred to as the Mechanics of Jewelry.
Exhibition Statement

In my youth you could usually find me doing one of the following: collecting rocks, usually variations of quartz because they were in abundance in my driveway and sparkled in the sun, perusing the latest edition of *Popular Mechanics*, or painting with my uncle. My artistic drive eventually led me to metals and jewelry design.

3-D computer design opened a whole new world to me. It finally gave me the ability to create what my mind had always envisioned, but my hands could not quite replicate. When my wife introduced me to the world of steampunk, everything finally came together, much as the gears of a clock.

My ideas and art are influenced more by the idea of steampunk, the era, the lifestyle, and the mechanics, than that of actual created works. I attempt to place myself in the era, and create what I feel a jeweler of that time would have designed.

I am inspired by the German jewelers Friedrich Becker and Abrasha who were both trained as engineers and take a more mechanical and technical approach in their work. I explore the elements of mechanics, stone setting and assembly. This unique combination of assemblage with industrial parts and gemstones is the work that I have created; it is what I refer to as The Mechanics of Jewelry.
Appendix

A. Fabrication of Gears from Gear Stock

Once I had obtained the different size gear stock that I intended on using for my projects, the next task at hand was how to cut the stock. I used various methods before I finally found a suitable solution. The following is the step by step process that I took in cutting out the gears needed for my work.

Tube Cutter:

My initial idea in cutting the gear stock was to use a jeweler’s tube cutter. A tube cutter has a V shaped notch that the tubing slides into, a lever that holds the tubing in place, a small guide that the saw blade fits through and a stop that allows you to cut consistent lengths, or thicknesses, from your stock. It quickly became evident that a tube cutter simply would not be large
enough to hold the gear stock.

**Constructed Jigs:**

The jeweler’s tube cutter works on the simple concept of having a V shaped notch to hold the stock and a perpendicular slit as a guide for the saw blade. I decided that the concept was easy enough and that I should be able to make a jig based on the same concepts. The first one that I made was constructed out of a piece of brass that I folded to make the V shaped notch, and I cut a slit in the metal as a guide for the blade. I believe this would have worked, if the jig had been constructed out of something harder than brass. I found that my saw blade would drift and I would inadvertently start to cut through the jig. This made the guide completely ineffective and the jig unsuitable.

Since I needed a harder material, I constructed the next jig out of steel angles used for construction. I screwed two angles to pieces of 2 x 4 pieces of wood leaving a very small gap in between the two angles that would be used as my guide. I failed to recognize however, that the previous jigs all had a front guide and a rear guide; having two guides was essential in keeping the saw blade perpendicular to the stock. I found that lacking two guides made it nearly impossible to maintain a consistent cut all the way through the stock without drifting one way or the other.
Miter Box and hack saw:

A miter box is a cutting jig that has various guides that allow for one to make relatively precise straight or angled cuts. I had previously used a Miter box to cut pieces from wax rods. I used an aluminum miter box and a hack saw in an attempt to cut the gear stock. I found that the hack saw, even with a finer blade, left very rough edges on the sides of the gears. The aluminum was too soft of a metal for me to use the jeweler’s saw. The miter box gave me consistently thick gears, but a lot of clean up was going to be necessary.

Metal Band Saw:

I finally settled on a gravity fed metal band saw to cut the gear stock. I was able to attach a stop to the saw that enabled me to consistently cut the same thickness in the gears. The blade did leave very rough edges, but the band saw was fairly consistent and it was much quicker than the hack saw and miter box.

Sanding the gears:

As I had mentioned, the metal band saw left fairly rough edges on the gears. To finish the gears, I would first remove any small burs from the gears with a file. After that I placed a piece of industrial strength double sided tape on a flat rubber sanding block. I then
taped a group of gears to the block and sanded down the gears using 320 grit sand paper and another flat surface. The gears were then removed from the tape, flipped over, and the other side was sanded. This would give me a group of consistently sanded gears to work with.

**Drilling the center holes:**

Drilling the holes by hand, with a perfectly straight up and down hole would have been near impossible to do on any sort of consistent basis. I decided to use a small drill press to make sure that I would be able to drill straight down through the gears. I constructed a jig that I was able to bolt to the base of the drill press that would hold the gears in place, but also ensure that I was drilling in the center of the gear. I found that the drill bit would tend to sway from one side to the next if I tried to drill too quickly, and my hole would not be at true center. This was remedied by using a center punch to give the drill a starting point as I drilled down.
B. 507 Mechanical Movements Diagrams

#24

#55

#92

#113

#127

#197
C. Five Gear Pendant

Quick sketch of the Five Gear Pendant

3D computer render of the Five Gear Pendant

Measurement diagram of the Five Gear Pendant

Finished Five Gear Pendant
D. Victorian style “V” Necklaces (Hinks, 127)
Works Cited


