Tesla Technology Research

Tesla Technology Research
2527 Treelane Ave.
Monrovia, Ca. 91016
(818) 359-1373
October 12, 1990

Battelle Memorial Institute
505 King Avenue
Columbus, Ohio, 43201-2693
Purchase Order No. Y 2949
Attn: Dr. James Corum

Dear Jim:

Enclosed is the technical information manual for the Model 10 Tesla Coil System that was delivered (in person) on October 5, 1990. It will provide a great deal of backgound information on the design parameters as well as serve as a useful guide when using this equipment in your experiments. I wish you and your team every success in you upcoming experiments! If you need any further assistance or additional equipments, please do not hesitate to call or write. My firm stands ready and anxious to serve your needs! Again, let me say thank you for the opportunity of your business.

Very truly yours,

William C. Wysock, President

TTR
COPY

ENCLOSURES: manual

WCW:bw

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 10 TESLA COIL TECHNICAL MANUAL

1.) GENERAL ASSEMBLY INSTRUCTIONS.

2.) TECHNICAL DESCRIPTION OF THE CONTROL RACK POWER SUPPLY.

3.) TECHNICAL DESCRIPTION OF THE HIGH VOLTAGE POWER SUPPLY TRANSFORMER.

4.) TECHNICAL DESCRIPTION OF THE MODEL 10 TESLA COIL BASE UNIT.

5.) TECHNICAL DESCRIPTION OF THE MODEL 10 TESLA SECONDARY COIL AND TOROID.

6.) TECHNIQUES FOR TUNING OF THE MODEL TEN TESLA COIL SYSTEM.

7.) WARRENTY INFORMATION

1.) An overhead crane, or at least a block and tackle attached to a clear overhang is required to assemble the Model 10 Tesla Coil. Attach the machine eye provided, to the top-mounted flange of the Secondary Coil. This unit has an approximate weight of 150 pounds. The Secondary Coil is then raised to a height such that the Model 10 Base Unit may be positioned directly underneath this coil. It is recommended that this task be performed by at least three persons; one on either of the Model 10 Base Unit, the third controlling the raising and lowering operation of the Secondary Coil. Rotate the Secondary Coil such that the porcelain feed-thru terminal at bottom, aligns with the short braided grounding strap, located on the upper deck of the Base Unit. Carefully lower the Secondary Coil, making sure that the right angle braces clear past the upper phenolic support ring, above the Base Unit Primary Coil form. Align these braces with their respective clearance holes in the upper deck of the Base Unit, and secure with the hardware provided. Attach the ground strap to the lower terminal of the Secondary Coil with the hardware provided. Move the entire assembly aside. Raise the 48" aluminum toroid to a height sufficient to clear the top of the Model 10 Unit. Remove the machine eye from the top of the Secondary Coil, and replace it with the threaded rod porvided. Place the Pyrex glass cylinder around this rod, then move the unit into position under the toroid. Carefully lower the toroid so that it rests evenly on the glass cylinder, with the threaded rod projecting through the center hole of the toroid. Secure hand-tight with the shoulder washer and wing nut provided. Make sure that the two corona guard half-rings are properly attached to their respective standoff insulators and corresponding ground straps. These half-rings should be positioned so that the end gaps between them are evenly spaced, with the rings parallel to the upper deck of the Base Unit. This completes the assembly proceedure for this system.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

2.) The control rack power supply is rated at 20 KVa continuous output, 25 KVa intermittent. The input power requirement is 240 V.A.C., 1 phase, 60 Hz, with a neutral in phase i.e., 120-0-120 volt, 240 volt end-to-end. PLEASE NOTE that the neutral is also used as CHASSIS GROUND in this system; (see schematic). The input connector is labeled SOURCE, the output connector is labled LOAD. Both connectors are Crouse-Hinds industrial types, with different sexes, so as to prevent improper connection. The input power cable is a 5-conductor # 8 A.W.G. with red/white and orange/black as HOT, and green as both NEUTRAL as well as CHASSIS GROUND. This cable terminates into a 3 conductor industrial screw-terminal block, for ease and adaptability in hook-up. When A.C. power is applied to the input cable, the two BLUE LIGHTS on the front panel labeled "SOURCE" will illuminate. Turning on the MAIN POWER breaker switch will illuminate the next two blue lights labled "SYSTEM". The next control in the normal power-up sequence is labeled "INTERLOCK 1". This is a rotary switch that will illuminate red when it is energized. This control is the first step in the system's sequential logic, and also energizes the on-board air cooling blower system, and the ROTARY GAP drive motor. The second step is the insertion of the key in the switch labeled "INTERLOCK 2". Activating this switch causes a second interlock relay to energize, and a corresponding red light to illuminate labeled "OPERATE READY". The red pushbutton labeled "LOCAL OPERATE" will now allow current to be output from the control rack to the high voltage power supply transformer. PLEASE NOTE that if INTERLOCK 2 is in the off position, there is no way for the high voltage transformer to be accidentally energized. This was installed as a primary safety consideration. The illuminated voltmeter on the left of the front panel is dedicated to monitoring the incoming LINE VOLTAGE to the control rack. The voltmeter on the right is switchable between SYSTEM VOLTS and LOAD VOLTS. In this way, it is possible to monitor the output voltage of the rack with or without the I/R voltage drop of the series connected triple-gang variable inductance. VT-1 is the VOLTAGE CONTROL triple-gang set of Superior Electric #1256 autotransformers and VT-2 is the CURRENT CONTROL triple-stack set of Superior Electric #1156 uints which as a group, are parallel connected, but as a unit, is used as a variable series inductance for power factor and current limiting control. (see schematic). The two ammeters on the upper panel are dedicated to monitor SYSTEM AMPS and LOAD AMPS, respectively. The ammeter to the right of the two voltmeters is dedicated to reading input LINE AMPS. PLEASE NOTE that the dial on this meter is calibrated with a scale that reads "0-50" amps. However, the current transformer feeding this meter is actually 0-100 amps; thus the label on the panel that reads "LINE AMPS 2X". The Kilowatt meter is calibrated and shows TRUE INPUT WATTS to the rack control cabinet. The significance of how to properly interpret readings from these meters is explained in the section entitled, "Techniques for Tuning of the Model Ten Tesla Coil System."
The remote control box contains the duplicate functions of "OPERATE READY" red light and "LOCAL OPERATE". The remote box is handy for energizing the system when the operator needs to be physically in a different location away from the rack for better visual observation, etc. The cable connecting the remote box is shielded, and the remote box is electrically grounded through to the chassis of the rack cabinet for safety. PLEASE NOTE that when using the remote box, it is still necessary to first insert the key in the switch marked "INTERLOCK 2" on the front of the rack cabinet, and enable this switch before you can proceed.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 10 TESLA COIL TECHNICAL MANUAL

3.) TECHNICAL DESCRIPTION OF THE HIGH VOLTAGE POWER SUPPLY TRANSFORMER.

The high voltage power supply transformer weighs approximately 1,300 lbs. Care must be taken in the physical movement of it, as well as the power supply rack. Both units are mounted on heavy duty swivel castors and since the center of gravity is fairly high on these two units, it is possible to accidentally tip them over, should two castors on any one side be caught in a discontinuity of the floor surface! This transformer has a nameplate near its mounting base. The low voltage terminals are rated as 240-0-240 volts; 480 volts end-to-end. Normal connection between the output of the control rack and these terminals may be either one end and center terminal, or the two end terminals, depending on the operation desirable. The secondary winding is internally taped; the tap switch being accessed through the 5" diameter service cover on the top plate of the transformer case. This switch is set in POSITION #1 for maximum output voltage setting; i.e., 34,400 V.A.C. The dielectric oil in this transformer is CERTIFIED P.C.B. FREE, as is the oil in the OSCILLATION CAPACITORS, located on the lower deck of the Model 10 Tesla Coil Base Unit. Any suitable cable may be employed as interconnects between the high voltage terminals of the transformer to the input terminals, (porcelain stand-off units,) located on the lower deck of the Base Unit. These cables may be of any desirable length. No series chokes are required in this connection as the BIL, (basic impulse level,) on the secondary of this transformer is rated at 150 KV. Further, the FINE TUNING of this system is significantly affected by any changes in the output impedance of the secondary winding of this transformer.

4.) TECHNICAL DESCRIPTION OF THE MODEL 10 TESLA COIL BASE UNIT.

The Model 10 Tesla Coil Base Unit is equipped with four swivel locking castors. There are two porcelain stand-off insulators which serve as the high voltage input terminals for connection to the H.V. transformer. A duplex type receptacle box is also located on the lower deck of the base unit for attachment of the 120 V.A.C. power line that drives the Rotary Gap motor. PLEASE NOTE that there is also a ground lug on the face of this box. This ground point SHOULD NOT be connected to the same physical grounding point as the Tesla Coil Ground itself, but rather should be carried off to a seperate grounding point; the Tesla Coil Ground conductor will have oscillatory transients on it which could induce unwanted voltage spikes on the chassis of the Rotary Gap. There are three each 0.1 mfd. 50 KV and two each 0.02 mfd. 20 KV polypropylene oscillation capacitors on the lower deck of the base unit. One 0.1 mfd. unit is connected in parallel with two series-connected 0.1 mfd. units, forming a combined capacity of 0.15 mfd. at 50 KV. The copper strap connecting the two 0.02 mfd. units in series, also serves to add a total of 0.01 mfd. in multiple, across the 50 KV units, yeilding a total capacity of 0.16 mfd. In normal operation, this series-connected strap between the two 0.02 mfd. units is omitted. These small capacitors are primarily for convenience as a tuning aid. All five capacitors are non P.C.B. dielectric oil filled units and are of new manufacture. The Rotary Gap utilizes 3/8" solid thoriated tungsten electrodes, and is driven by a salient-pole 1800 R.P.M. motor, which requires approximately 4 seconds to achieve normal running speed after being energized. The large phenolic stationary electrode holder disc may be rotated about its axis by loosening a locking hex-socket cap screw near the base of the Rotary Gap chassis. This rotation affords approximately 40 degrees of dwell adjustment for tuning purposes. The commutator ring on the rotating disc has been modified for heavy duty service, and should not require any maintenance, under normal operating conditions.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 10 TESLA COIL BASE UNIT-CONTINUED

The flexible interconnect cables on this unit are 250 MCM size, and are provided in a length sufficient to attach to any point(s) on the Tesla Primary Coil assembly. The Primary coil is formed from 5/8" diameter annealed copper tubing. Care should be taken to keep this tubing clean, for maximum electrical contact with the Primary Cable interconnects. The entire Primary Coil assembly may be raised or lowered in zenith, according to the required "Q" of a particular configuration. This is a feature not normally associated with Tesla Coil design of this magnitude, but in practice, is most useful! PLEASE NOTE that the upper deck and Primary Coil of the Model 10 Tesla Coil Base Unit is elevated a CERTAIN DISTANCE above the floor, (ground plane.) In practice, it has been shown that a coil system of this size and power, requires a certain minimum distance for decoupling the electromagnetic field of the Primary Coil from the [virtual] ground plane. Conveniently, this design also provides for the close physical association of related Primary Tank Oscillator components, thereby reducing stray inductance to a practicable minimum. The two upper deck corona guard rings are employed to protect the Primary Circuit from stray downward propagating discharges from the Tesla Secondary Coil toroid. The design of these two rings is such that they do not create an eddy current loop, which would otherwise significantly reduce the "Q" of this circuit. MAKE SURE that these guard rings are in place at all times, and that their respective grounding straps are properly connected.

5.) TECHNICAL DESCRIPTION OF THE MODEL 10 TESLA SECONDARY COIL AND TOROID.

The secondary coil is wound on a fiberglas cylindrical form measuring 108" long by 24" in diameter. The wire is #10 A.W.G. stranded, p.v.c. insulated jacket, approximately 2,400 feet in length. The red coating on the coil form is electrical glypt varnish. The coil is wound at the rate of approximately 3.5 turns per inch. The ground connection is made via a porcelain feed-thru bushing, and the high voltage end of the winding is terminated in a center-mounted 1/2 inch n.p.t. flange. This coil assembly weighs approximately 150 pounds. The coil must be protected from excessive moisture and dirt at all times, to insure maximum performace. The aluminum hollow-spun toroid discharge electrode measures 48" in diameter by 12" in cross-section. The pyrex glass tubing cylinder provides the required spacing between the top of the secondary coil and the lower part of the toroid. Three chains and closed metal ring provide a fixture for handling attachment and removal of the toroid to the secondary coil.

6.) TECHNIQUES FOR TUNING OF THE MODEL 10 TESLA COIL SYSTEM.

It is imperative to remember that optimum performance of this system will only be realized when ALL VARIABLES are carefully taken into account. Chief amoung these are; VOLTAGE CONTROL, CURRENT CONTROL, TAP SELECTION ON BOTH THE PRIMARY AND SECONDARY WINDINGS OF THE HIGH VOLTAGE POWER SUPPLY TRANSFORMER, ROTARY GAP DWELL ANGLE AND GAP SPACING, TESLA PRIMARY TAP LOCATION AND ELEVATION, TOTAL PRIMARY COIL INDUCTANCE AND CAPACITANCE, COIL LOCATION WITH RESPECT TO ADJACENT WALLS, ETC., and TOTAL SECONDARY COIL SERIES TERMINAL CAPACITANCE. The exact set of parameters found to be best for a given environment or operating group of circumstances are too numerous to list here. It is sufficient however, to state that there are certain "benchmarks" one should look for as indicators for the best tuning of this system. Minimum LINE AMPS and maximum KILOWATTS as well as LOAD VOLTS [resonant rise] higher then SYSTEM VOLTS meter readings, all translate into highest power factor and maximum "forward-going" real power in this system.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TECHNIQUES FOR TUNING OF THE MODEL 10 TESLA COIL SYSTEM-CONTINUED.

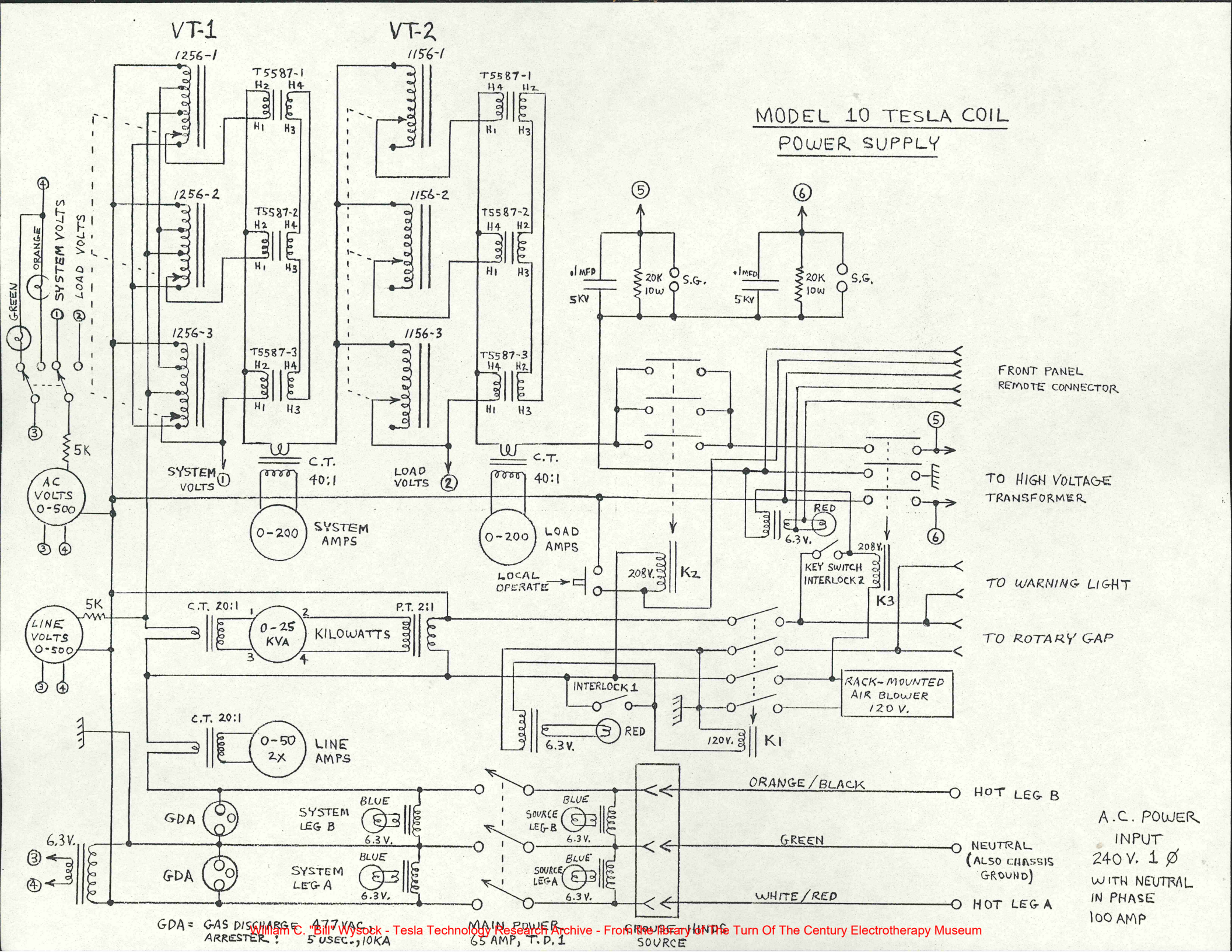
VT-1 (the voltage control autotransformer,) serves primarily as a means of adjusting Tesla Coil output voltage and current. VT-2 (the variable series inductance autotransformer,) serves as an adjunct CURRENT CONTROL as well as adjusting system power factor. Changes in positioning of the dwell index angle on the Rotary Gap will have a direct effect on the exact positioning of VT-2. For the purposes of diagostic tuning proceedure, it is advisable to attach a metal rod to the toroid discharge electrode, in such a manner that it protrudes out to one side, to concentrate the corona discharge from a single point, and provide a quantitative means of judging the coil's performance. Additional Secondary Coil parallel capacitance may be easily arranged by positioning the location of the coil equidistant from two adjoining right angle walls [OF SUFFICIENT HEIGHT,] at about 25 feet apart. The above mentioned parameters will change somewhat, but with the correct adjustment, experience has shown this system to produce a discharge over 27 feet in length, (measured in a straight line.) A series connected stationary gap may be added to the Primary Tank Circuit in one of several ways; multiple section stationary gaps with a strong air blast, or a pressurized single series gap in an atmosphere of nitrogen or sulpher hexifluoride.

The integrity of the Tesla Secondary Ground system deserves special attention to detail. It is absolutely essential to provide a SEPERATE EARTH GROUND to the GROUND TERMINAL on the upper deck of the Model 10 Tesla Coil Base Unit which possess the following electrical characteristics; (1) low R.F. impedance at the fundemental operating frequency, and (2) non resonant physical length. Practice has shown that this is not as simple and straight forward as it might appear; the bottom line here is, "THE ONLY THING YOU CAN TAKE FOR GRANTED IS NOTHING AT ALL."

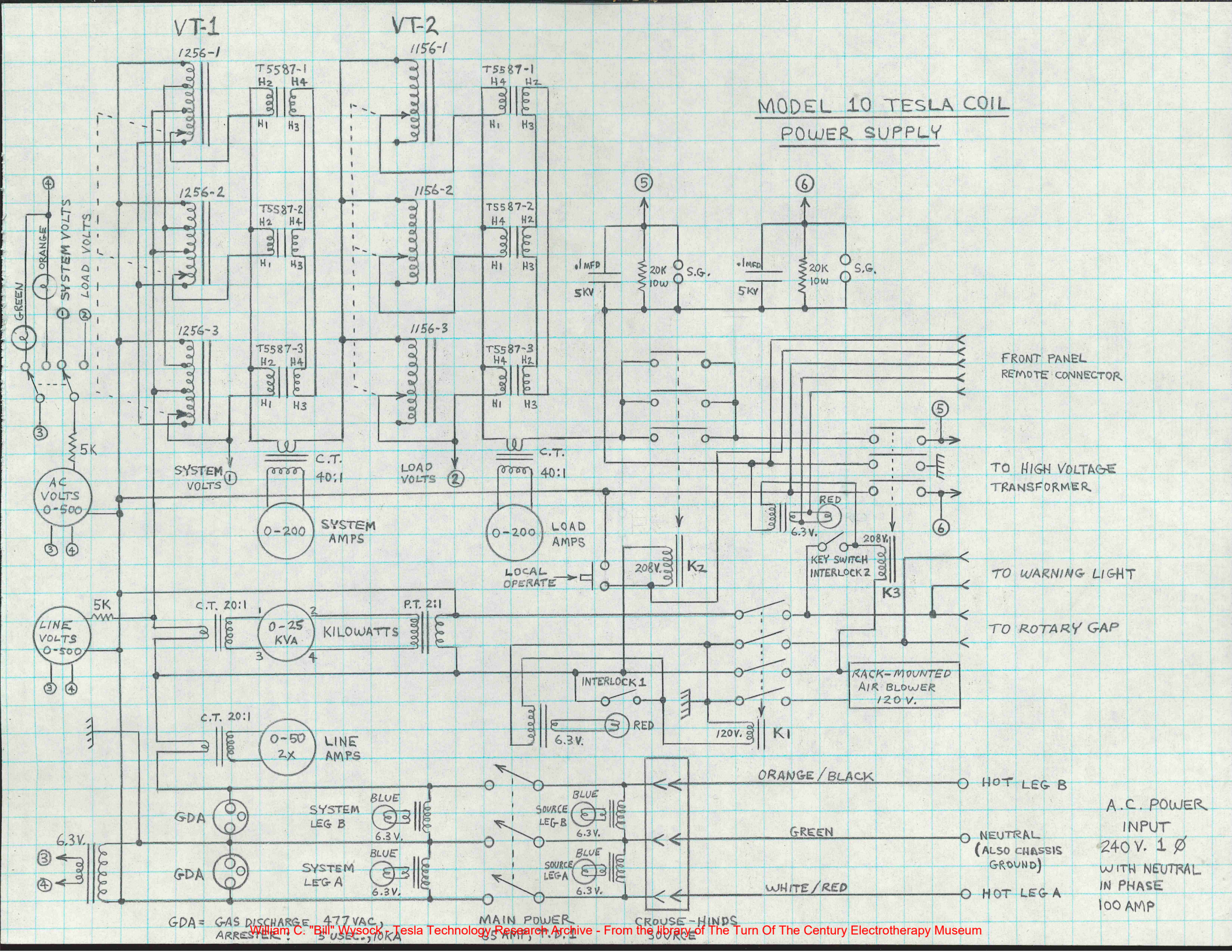
7.) WARRENTY OF THE MODEL 10 TESLA COIL SYSTEM.

Tesla Technology Research warrents the entire Model 10 Tesla Coil System to be in good working condition, at the time of origional delivery to the customer. As stated in the origional contractual agreement and disclosure, this equipment IS IN USED CONDITION, with the sole exception of the oscillation capacitors, which are supplied as NEW UNITS. Due to the nature of intended operation of, [and modification(s) to] this equipment, NO OTHER WARRENTY IS EITHER EXPRESSED OR IMPLIED. The customer shall bear ALL LIABILITY(S), both direct and indirect, for any use(s) of this equipment, after the point of origional delivery to the same. Tesla Technology Research understands and respects the confidential nature of the customer's intended application(s) for this equipment, and shall at all times abide by and comply fully with, all applicable D.O.D. classification restrictions. Tesla Technology Research RESERVES THE RIGHT TO DUPLICATE ANY AND ALL EQUIPMENTS as origionally supplied to the customer, for its own intended purposes in the indefinite future. Tesla Technology Research shall remain available on an "as needed basis," for any requested technical assistance from the customer.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

american
CLASSIC
SCREEN
magazine
A JOURNAL FOR THE PRESERVATION OF THE MOTION PICTURE INDUSTRY

P.O. Box 7150
Overland Park, KS 66207

SECOND CLASS POSTAGE
PAID AT
SHAWNEE MISSION, KS 66202

american CLASSIC SCREEN

The Journal Of America's Film Heritage

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

0195-8267

$2.00

american CLASSIC SCREEN

JAN/FEB, 1983

The Journal of America's Film Heritage



RECOLLECTIONS OF JOAN CRAWFORD AND OTHER SCREEN LADIES

INTERVIEWS WITH RALPH BELLAMY AND RON HOWARD

PUTTING A ''SPARK'' INTO HORROR FILMS

THE CAREER OF WARNER BAXTER

Tibbetts '82

3142401919

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

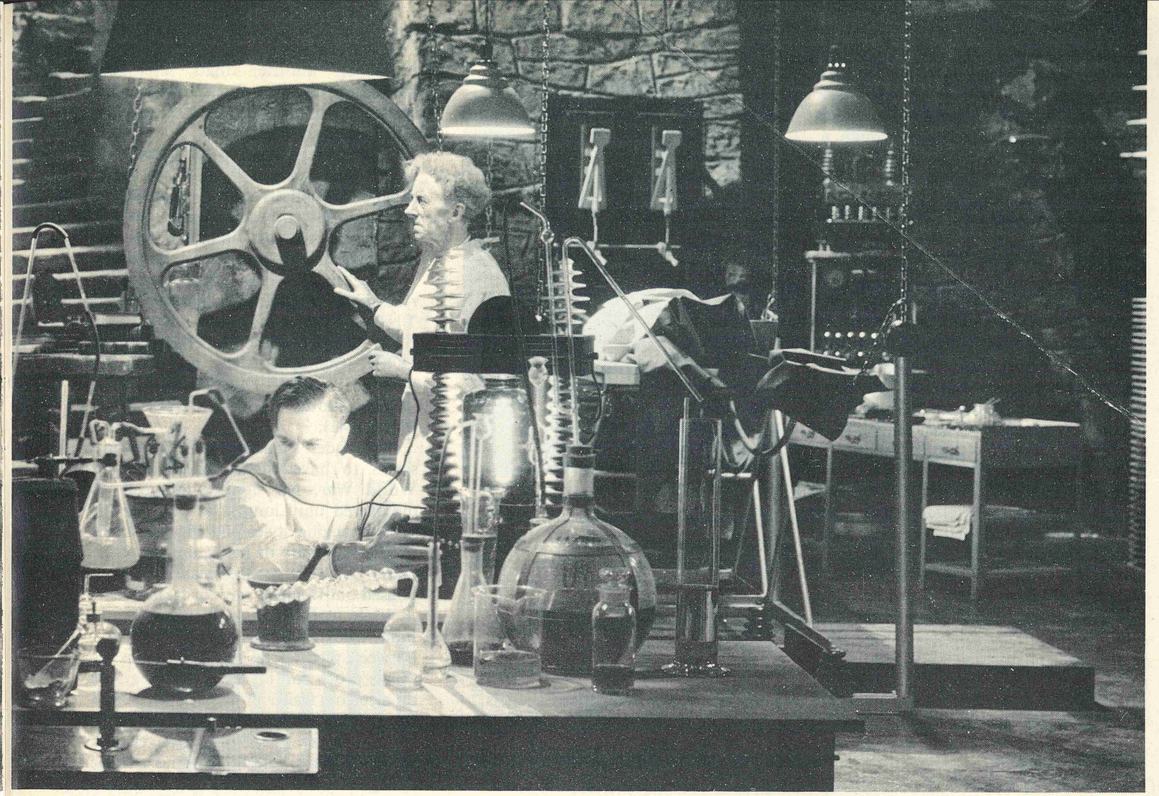
MISTER ELECTRICITY:

THE MULTI-VOLTED CAREER OF KENNETH STRICKFADEN

by William Ludington



A scene from THE BRIDE OF FRANKENSTEIN showing some of the gadgetry invented by special effects wizard Kenneth Strickfaden.



Picture Fu Manchu (Boris Karloff), the Frankenstein monster (Karloff again), and Chandu the Magician (Bela Lugosi) — all bathed in electronic numbuses of light. Think of all the death rays of departed Saturday afternoon matinees that destroyed a thousand cities. Remember the exotic laboratory of the villainous Emperor Ming in the FLASH GORDON serials. Think of those and a host of other electrical marvels and you have the work of one man — Kenneth Strickfaden. His was the mind of a thousand volts. . . and some of the most "highly charged" special effects Hollywood has ever come up with.

Most dabblers in the realm of electricity have probably, at one time or another, constructed what is known as a Tesla coil. Named for its inventor, Nikola Tesla, the Tesla coil is simply an induction coil used to develop a high-voltage, high frequency, oscillatory discharge. Kenneth Strickfaden, a veteran of the First World War and an electrical hobbyist, made these things in his Santa Monica, California home for the amusement of himself and his neighbors. He also built other electrical effects, all of which had been originally discovered and perfected by Tesla before the turn of the century. These included the "Jacob's Ladder" effect with its ever-ascending tiers of electric flames between two diverging wires; electric pinwheels with their exciting gyration of sparks; electrostatis generators demonstrating lightning and St. Elmo's Fire; and on and on. As with Tesla, his spiritual mentor, this young hobbyist always strived for bigger and better effects. The way in which they were constructed displayed a certain sculptural quality reflecting the Art Deco style of the period. And so it was, that around the year 1930, the great megaphone of Hollywood called his name.

When Strickfaden arrived in Hollywood his peculiar talents were immediately put to use for minor electrical effects in a number of movies. The advent of sound in the movies certainly opened the door to many creative and exciting possibilities for such effects as those presented by Strickfaden. His first film job was to produce a realistic sound of a condemned man being executed in the electric chair. Two thousand volts repeated four times, with five hundred volts in between, has been the grim procedure required for this execution. To obtain this sound he passed a high frequency current through a block of wood. The wood offered a resistance to the current and made a sizzling noise with a resulting wisp of smoke that drifted lazily across the set. After this ominous debut he was then assigned to blow up a tree with a bolt of lightning. This was relatively simple. He ran some wire up a prop tree. The wire was connected to a high voltage generator. When it was turned on there was a flash of light and the tree crashed, demolishing in its path a native hut. For another film he rigged up a rotary spark gap for a wireless station sound effect on board a ship. An appropriate sound resulted when he condensed a high voltage spark. The electrical stunts became more difficult when he was called upon to build a machine supposedly capable of emitting a ray that would interfere with the ignition of an automobile. The ray machine was a box-like cabinet composed of various lenses, bulbs, coils, and dials. Although it was only a prop it appeared as though it was capable of strange activities such as emitting all kinds of rays.

In early 1931 a film version of Mark Twain's *A Connecticut Yankee in King Arthur's Court* was released by Fox. This was the first sound version, with the title shortened to A CONNECTICUT YANKEE; it starred Will Rogers. Strickfaden created for this film a gigantic and mysterious radio set that supposedly had the power to bring back the sound of past ages. He called it "the retrogressive wave charger". When it was used in connection with a high frequency generator it produced artificial lightning.

The film with which Kenneth Strickfaden has been most closely associated is Universal's classic horror production, FRANKENSTEIN (1931). The script of FRANKENSTEIN called for a laboratory where lightning from the stormy heavens would be captured and channeled down into the inanimate monster (Boris Karloff), restoring him to life. For this Strickfaden built an apparatus based on the principle of the horn gap and designed it as the "Lightning Bridge". He was aided in the construction of this and other laboratory gadgetry by Raymond Lindsay and Frank Graves. Raymond Lindsay usually worked as "chief electrician" for a firm called "Scientific Films, Inc." Frank Graves had worked for Universal Studios since 1915 as their "chief electrician". The construction of this particular set with its "lightning bridge" and other flashy effects necessitated moving half a ton of equipment over the Monster's operating table. It was very difficult for the three electricians to work up there as they did during the famous life creation scene. According to Boris Karloff, in an article called "Memoirs of a Monster" (*Saturday Evening Post*, November 3, 1962), he was quite uneasy doing this scene. Karloff lay half-naked, strapped to that operating table and directly above he could see these "special effects men brandishing the white-hot scissors-like carbons that made the lightning." Karloff concluded by saying that he "hoped that no one up there had butterfingers!" Rumors about this fantastic set and its electrical effects made people curious. As a publicity stunt, Universal invited people from all over the area to come to witness the electrical pyrotechnics of the Frankenstein creation scene. This, and Boris Karloff's makeup as the Monster, gave the film its long celebrated trademarks.

Next there was a low-budget film called MURDER AT DAWN (Big 4-1932), and "old dark house" mystery, where Strickfaden built a device used to harness the sun's energy. It was called a "DXL Accumulator".

After this he worked on CHANDU, THE MAGICIAN (Fox-1932) starring Edmund Lowe and Bela Lugosi. This was a silly, but rather artistic, occult thriller directed by the set designer, William Cameron Menzies. Strickfaden's contribution to this production was a disintegrating death ray. Studio officials wanted sparks to appear all over the large ray gun, and as the infernal machine was destroyed, the barrel was supposed to melt and an electrical control handle burn off and fall to the floor. To accomplish this, huge amperages were needed to produce instantaneous heat, and a complicated and delicate resonator apparatus was used to create a spark six feet long. For this scene to be photographed it was necessary to hoist the apparatus overhead, thus making matters very difficult. The ray gun, and its photography, provide one of the most memorable scenes in this movie.

A much more spectacular picture, made with Strickfaden's electrical effects and properties, appeared toward the end of 1932. This was THE MASK OF FU MANCHU produced by MGM. Boris Karloff, on loan to MGM by Universal, portrayed the evil Oriental scientist. During a scene in this picture Karloff as "Fu" was to transfer a six-foot 1,500,000-volt arc from the ball terminal of a piece of strange apparatus to the presumed sword of Genghis Khan as a test of its authenticity. Approaching the roaring machine he was to calmly intercept the awesome spark on his long Chinese fingernails and channel it to the sword. If this was truly the sword of the Great Khan it would not melt but would withstand the high amperage. For this purpose a sword made of brass and another made of gilded wax and magnesium powder were employed.

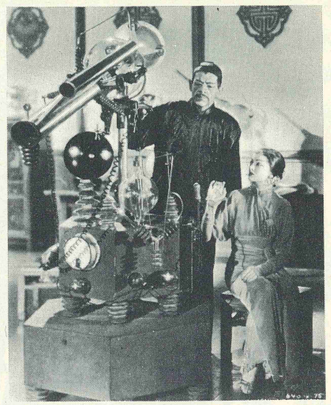
Strickfaden was required to double for Karloff in the sword-testing scene. Karloff would have no part of this stunt which he considered too dangerous. Trick photography was ruled out for the scene, so Strickfaden, who occassionally doubled actors in handling his electrical devices, dressed up as Fu Manchu taking

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

every possible precaution. A wire concealed under the Oriental costume was run from long copper fingernails to the resonator apparatus ground through a safety gap. At this point the director called for action. A low hum from the apparatus grew louder as the arc developed from the electrode to the tips of the copper fingernails. The spark was reaching its full intensity and Strickfaden was on the verge of tranferring it to the sword when, suddenly, he did a convulsive back flip with the fire still flowing from his fingernails. Immediately the electricity was shut off, the camera stopped rolling and the stunned man was helped to his feet. The problem was soon detected. It was a smoking cable that carried 70,000 volts from the transformer to the rotary gap. The cable had been punctured. An ensuing arc was formed across the flooring to a pipe underneath. The circuit was completed up through Strickfaden's body along the wire on his arm to the safety horn gap which broke the circuit and averted possible electrocution. After repairs were made and the cable moved, a final take was completed without further difficulty. The only sensation experienced by Strickfaden during this incident was that of a strangely painless flash of light. However, his back became sore and this lasted for some time.

One other spectacular, fantastic prop used in this film was an electrical death ray gizmo. In the climax of the movie, Fu's infernal machine goes haywire and destroys him and his followers. This contraption was very similar to the disintegrating death ray in CHANDU, THE MAGICIAN.

Then along came the preposterous serial called THE LOST CITY (Krellberg-1935) utilizing such Strickfaden equipment as a large death ray, a machine to destroy people's wills,



Some of Strickfaden's most spectacular special electrical effects appeared in THE MASK OF FU MANCHU (1932) — especially the scene where Karloff transfers a powerful electrical spark from his hands to the sword of Genghis Khan. Here, Karloff and Myrna Loy examine a Death Ray Machine.

television, and miscellaneous gadgets.

Later in 1935 a sequel to FRANKENSTEIN was released by Universal. This was BRIDE OF FRANKENSTEIN making use of practically all the same lab equipment used in the original 1931 production.

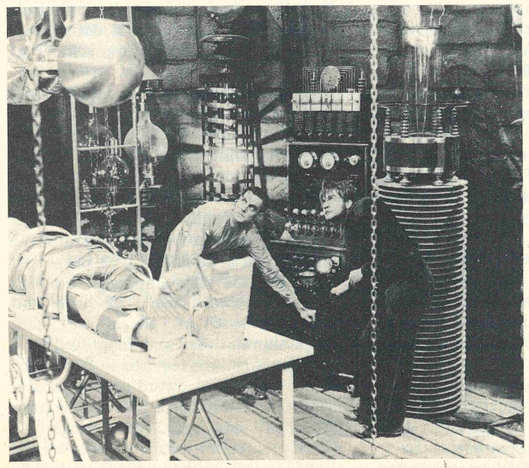
During the next year, 1936, Strickfaden did work for at least three productions. He equipped two gadget-laden serials. For the serial, FLASH GORDON (Univ.-1936), he fitted out the laboratory used by Dr. Zarkov on Planet Mongo. More lab equipment and gizmos were in the serial THE CLUTCHING HAND (Stage & Screen-1936). And strangely enough his equipment was used to stock another mad scientist's laboratory; this time for a B-western entitled THE GHOST PATROL (Puritan -1936) starring Tim McCoy.

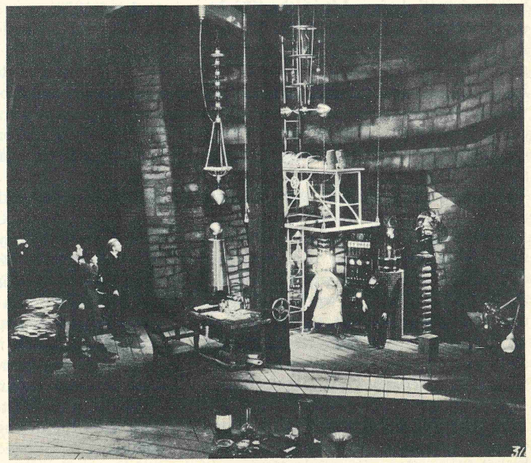
There have probably been other films and serials made in the Thirties where Strickfaden and his equipment have been involved. Sometimes his name is seen in the credits and other times it is not. But his equipment is usually recognizable. Among many films with equipment resembling Strickfaden's are the serials THE VANISHING SHADOW (Univ.-1934), THE FIGHTING DEVIL DOGS (Republic-1938), and features SON OF FRANKENSTEIN (Univ. -1939) and THE DEVIL BAT (PRC-1941).

Strickfaden's initial stint in Hollywood seems to have ended by the Second World War. No sign of him can be discovered until long after that period. With changing styles and the possibility of over-exposure of his equipment in so many films, his services may have been phased out to make way for fresh talent.

While working in Hollywood Strickfaden also carried on a sideline activity. Between pictures he would load up his movie props and high voltage apparatus on a custom trailer of his own design and take them on tour. His electrical circus included music over light beams, electric snow, artificial lightning, photo electric and gaseous tube effects.

Kenneth Strickfaden, now well into his eighties, still travels around California with his collection of electrical gadgets giving lectures and demonstrations at high schools and colleges. His name and reputation grow more popular with film buffs every year. About ten years ago he was called upon by Hollywood to once again render his peculiar talents and equipment in the production of several films. In the lurid, low-budget horror picture entitled DRACULA VS.





Two shots of the fabulous Strickfaden-designed laboratory in FRANKENSTEIN. Much of this equipment was used later in THE BRIDE OF FRANKENSTEIN (1935) and more recently in Mel Brooks' YOUNG FRANKENSTEIN.

insulting to him since he must obviously cherish these gadgets (as well as his privacy).

The kind of films that incorporated strange electrical effects always made a difficult job for a technician like Strickfaden. These films called for authentic apparatus that would perform sensational displays usually possible only in large electrical research labs furnished with expensive equipment. Not all the gadgets seen in these movies, however, were required to work — many of them just sat around filling in space and looked atmospherically impressive. Strickfaden was expected to have in stock a wide array of every kind of apparatus that might be needed. If he did not have it he would go home to Santa Monica and build it overnight. Many pieces of apparatus were used over and over again in different films, sometimes slightly altered or disguised. Quite a few of these pieces were originally used in the 1931 FRANKENSTEIN picture. Strickfaden did have names for some of these things such as the "DXL Accumulator", "Lightning Screen", "Dynascope", "Retrogressive Wave Charger", and the "High Amperage Pyrogeyser". And they've all glowed, pulsated, hummed, crackled, and sparked their way into the hearts of millions of movie fans for over the last half century.

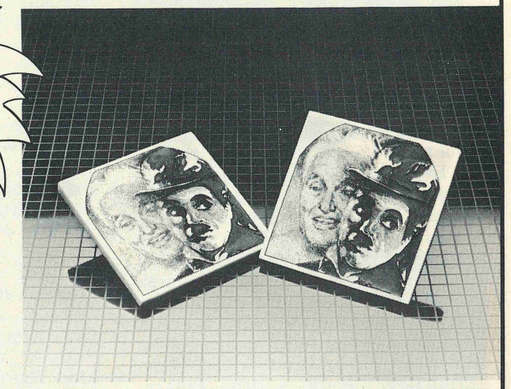
William Ludington lives in Silver Spring, Maryland.

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 2178
POSTAGE WILL BE PAID BY
AMERICAN CLASSIC SCREEN
P.O. Box 7150
Overland Park, Kansas 66207

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

MITED EDITION MARBLE ART

95 each
of four
40.00



ALLY
ED

SIZE:

ne face is more symbolic of Hollywood or the movies than that of the legendary Charlie Chaplin. This handsome rendering (from an original *ACS* cover painting by John Tibbetts) is finely engraved on white marble and is of a limited edition of 100. The mold *has been* destroyed and there will be no more cast!

The classic etching captures Chaplin as a young and old man and is truly a versatile collector's piece. It may be framed for use as a handsome wall decoration or used as a coaster, desk ornament or wonderful conversation piece for your coffee table or book case.

It is the first in a series of *ACS* limited editions and is a classy and eye-catching gift or personal item. . . your way of saying "I love the movies."

NAME: _____

ADDRESS: _____

CITY/STATE/ZIP: _____

Please send me _____ limited edition Chaplin renderings at $12.95 each or _____ set(s) at $40.00. (Orders will be filled by postmark dates while supply lasts.)

Check One:
☐ My check is enclosed
☐ Charge to MasterCard
☐ Charge to Visa
Credit Card No. _____
Expiration Date: _____

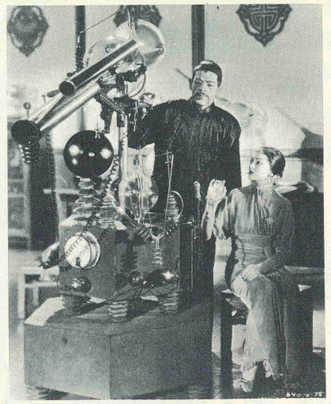
Make checks payable and return to:
American Classic Screen
8340 Mission Rd., Suite 106
Shawnee Mission, KS 66206

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

every possible precaution. A wire concealed under the Oriental costume was run from long copper fingernails to the resonator apparatus ground through a safety gap. At this point the director called for action. A low hum from the apparatus grew louder as the arc developed from the electrode to the tips of the copper fingernails. The spark was reaching its full intensity and Strickfaden was on the verge of tranferring it to the sword when, suddenly, he did a convulsive back flip with the fire still flowing from his fingernails. Immediately the electricity was shut off, the camera stopped rolling and the stunned man was helped to his feet. The problem was soon detected. It was a smoking cable that carried 70,000 volts from the transformer to the rotary gap. The cable had been punctured. An ensuing arc was formed across the flooring to a pipe underneath. The circuit was completed up through Strickfaden's body along the wire on his arm to the safety horn gap which broke the circuit and averted possible electrocution. After repairs were made and the cable moved, a final take was completed without further difficulty. The only sensation experienced by Strickfaden during this incident was that of a strangely painless flash of light. However, his back became sore and this lasted for some time.

One other spectacular, fantastic prop used in this film was an electrical death ray gizmo. In the climax of the movie, Fu's infernal machine goes haywire and destroys him and his followers. This contraption was very similar to the disintegrating death ray in CHANDU, THE MAGICIAN.

Then along came the preposterous serial called THE LOST CITY (Krellberg-1935) utilizing such Strickfaden equipment as a large death ray, a machine to destroy people's wills,



Some of Strickfaden's most spectacular special electrical effects appeared in THE MASK OF FU MANCHU (1932) — especially the scene where Karloff transfers a powerful electrical spark from his hands to the sword of Genghis Khan. Here, Karloff and Myrna Loy examine a Death Ray Machine.

television, and miscellaneous gadgets.

Later in 1935 a sequel to FRANKENSTEIN was released by Universal. This was BRIDE OF FRANKENSTEIN making use of practically all the same lab equipment used in the original 1931 production.

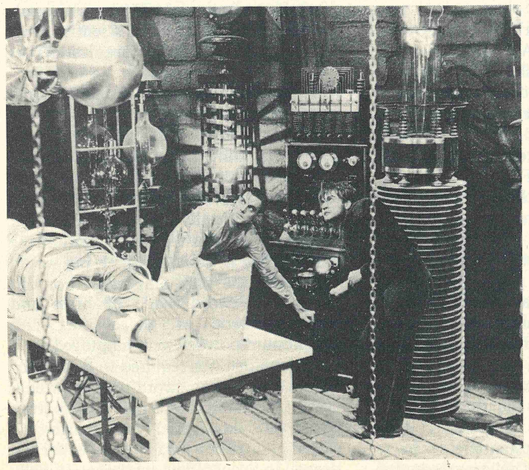
During the next year, 1936, Strickfaden did work for at least three productions. He equipped two gadget-laden serials. For the serial, FLASH GORDON (Univ.-1936), he fitted out the laboratory used by Dr. Zarkov on Planet Mongo. More lab equipment and gizmos were in the serial THE CLUTCHING HAND (Stage & Screen-1936). And strangely enough his equipment was used to stock another mad scientist's laboratory; this time for a B-western entitled THE GHOST PATROL (Puritan -1936) starring Tim McCoy.

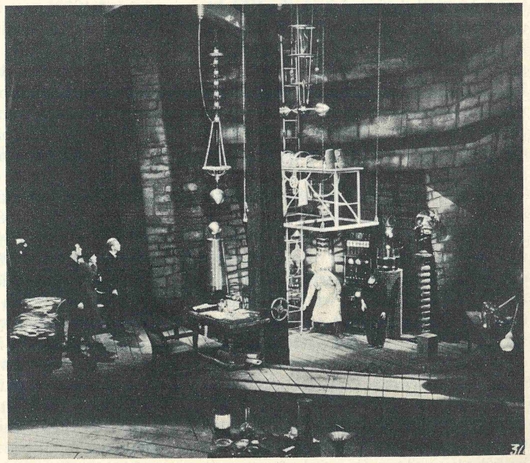
There have probably been other films and serials made in the Thirties where Strickfaden and his equipment have been involved. Sometimes his name is seen in the credits and other times it is not. But his equipment is usually recognizable. Among many films with equipment resembling Strickfaden's are the serials THE VANISHING SHADOW (Univ.-1934), THE FIGHTING DEVIL DOGS (Republic-1938), and features SON OF FRANKENSTEIN (Univ. -1939) and THE DEVIL BAT (PRC-1941).

Strickfaden's initial stint in Hollywood seems to have ended by the Second World War. No sign of him can be discovered until long after that period. With changing styles and the possibility of over-exposure of his equipment in so many films, his services may have been phased out to make way for fresh talent.

While working in Hollywood Strickfaden also carried on a sideline activity. Between pictures he would load up his movie props and high voltage apparatus on a custom trailer of his own design and take them on tour. His electrical circus included music over light beams, electric snow, artificial lightning, photo electric and gaseous tube effects.

Kenneth Strickfaden, now well into his eighties, still travels around California with his collection of electrical gadgets giving lectures and demonstrations at high schools and colleges. His name and reputation grow more popular with film buffs every year. About ten years ago he was called upon by Hollywood to once again render his peculiar talents and equipment in the production of several films. In the lurid, low-budget horror picture entitled DRACULA VS.





Two shots of the fabulous Strickfaden-designed laboratory in FRANKENSTEIN. Much of this equipment was used later in THE BRIDE OF FRANKENSTEIN (1935) and more recently in Mel Brooks' YOUNG FRANKENSTEIN.

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 2178
POSTAGE WILL BE PAID BY
AMERICAN CLASSIC SCREEN
P.O. Box 7150
Overland Park, Kansas 66207

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

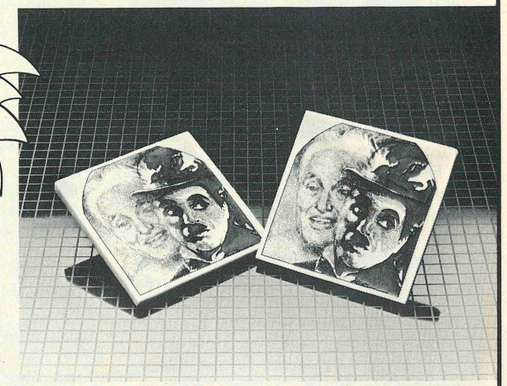
insulting to him since he must obviously cherish these gadgets (as well as his privacy).

The kind of films that incorporated strange electrical effects always made a difficult job for a technician like Strickfaden. These films called for authentic apparatus that would perform sensational displays usually possible only in large electrical research labs furnished with expensive equipment. Not all the gadgets seen in these movies, however, were required to work — many of them just sat around filling in space and looked atmospherically impressive. Strickfaden was expected to have in stock a wide array of every kind of apparatus that might be needed. If he did not have it he would go home to Santa Monica and build it overnight. Many pieces of apparatus were used over and over again in different films, sometimes slightly altered or disguised. Quite a few of these pieces were originally used in the 1931 FRANKENSTEIN picture. Strickfaden did have names for some of these things such as the "DXL Accumulator", "Lightning Screen", "Dynascope", "Retrogressive Wave Charger", and the "High Amperage Pyrogeyser". And they've all glowed, pulsated, hummed, crackled, and sparked their way into the hearts of millions of movie fans for over the last half century.

William Ludington lives in Silver Spring, Maryland.

MITED EDITION MARBLE ART

95 each
of four
40.00



ALLY
ED

SIZE:

ne face is more symbolic of Hollywood or the movies than that of the legendary Charlie Chaplin. This handsome rendering (from an original **ACS** cover painting by John Tibbetts) is finely engraved on white marble and is of a limited edition of 100. The mold *has been* destroyed and there will be no more cast!

The classic etching captures Chaplin as a young and old man and is truly a versatile collector's piece. It may be framed for use as a handsome wall decoration or used as a coaster, desk ornament or wonderful conversation piece for your coffee table or book case.

It is the first in a series of **ACS** limited editions and is a classy and eye-catching gift or personal item. . . your way of saying "I love the movies."

NAME: _____

ADDRESS: _____

CITY/STATE/ZIP: _____

Please send me _____ limited edition Chaplin renderings at $12.95 each or _____ set(s) at $40.00. (Orders will be filled by postmark dates while supply lasts.)

Check One:
☐ My check is enclosed
☐ Charge to MasterCard
☐ Charge to Visa

Credit Card No. _____

Expiration Date: _____

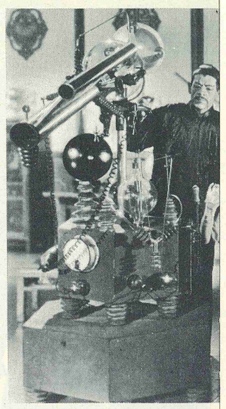
Make checks payable and return to:
American Classic Screen
8340 Mission Rd., Suite 106
Shawnee Mission, KS 66206

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

every possible precaution. A wire concealed under the Oriental costume was run from long copper fingernails to the resonator apparatus ground through a safety gap. At this point the director called for action. A low hum from the apparatus grew louder as the arc developed from the electrode to the tips of the copper fingernails. The spark was reaching its full intensity and Strickfaden was on the verge of tranferring it to the sword when, suddenly, he did a convulsive back flip with the fire still flowing from his fingernails. Immediately the electricity was shut off, the camera stopped rolling and the stunned man was helped to his feet. The problem was soon detected. It was a smoking cable that carried 70,000 volts from the transformer to the rotary gap. The cable had been punctured. An ensuing arc was formed across the flooring to a pipe underneath. The circuit was completed up through Strickfaden's body along the wire on his arm to the safety horn gap which broke the circuit and averted possible electrocution. After repairs were made and the cable moved, a final take was completed without further difficulty. The only sensation experienced by Strickfaden during this incident was that of a strangely painless flash of light. However, his back became sore and this lasted for some time.

One other spectacular, fantastic prop used in this film was an electrical death ray gizmo. In the climax of the movie, Fu's infernal machine goes haywire and destroys him and his followers. This contraption was very similar to the disintegrating death ray in CHANDU, THE MAGICIAN.

Then along came the preposterous serial called THE LOST CITY (Krellberg-1935) utilizing such Strickfaden equipment as a large death ray, a machine to destroy people's wills,



Some of Strickfaden's mo special electrical effects app MASK OF FU MANCH especially the scene w transfers a powerful electri his hands to the sword of G Here, Karloff and Myrna L Death Ray Machine.

television, and miscellaneo

Later in 1935 a sequel to STEIN was released by U was BRIDE OF FRANKEN ing use of practically all equipment used in the orig duction.

During the next year, 1936, Strickfaden did work for at least three productions. He equipped two gadget-laden serials. For the serial, FLASH GORDON (Univ.-1936), he fitted out the laboratory used by Dr. Zarkov on Planet Mongo. More lab equipment and gizmos were in the serial THE CLUTCHING HAND (Stage & Screen-1936). And strangely enough his equipment was used

Please rush my first issue of **AMERICAN CLASSIC SCREEN** and **NATIONAL FILM SOCIETY** membership materials.

NAME_____

ADDRESS_____

CITY_____

STATE_____ **ZIP**_____

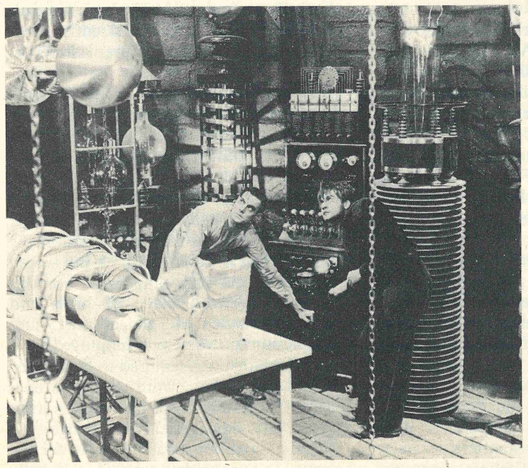
Check one:
___My check enclosed
___Chg. to Master Charge
___Chg. to VISA
Credit Card #:_____
Interbank # (Master Charge only):_____

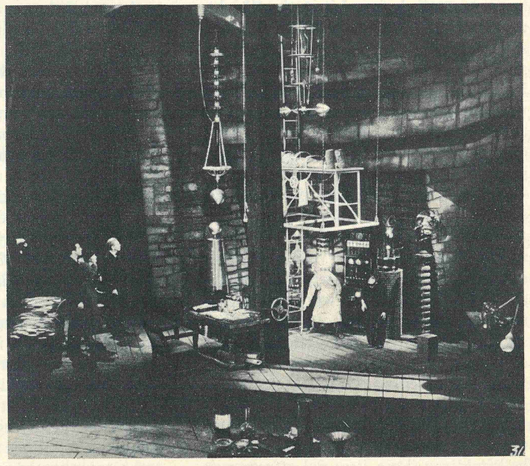
Check one:
American Classic Screen
___1 yr. $15 *(6 issues)
___2 yr. $28 *(12 issues)

Return to:
AMERICAN CLASSIC SCREEN
P.O. Box 7150
Overland Park, Ks. 66207

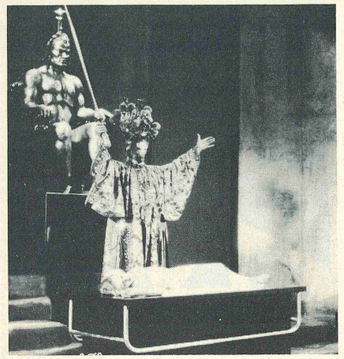
*Includes $5.00 per year membership in the National Film Society.

eighties, still travels around California with his collection of electrical gadgets giving lectures and demonstrations at high schools and colleges. His name and reputation grow more popular with film buffs every year. About ten years ago he was called upon by Hollywood to once again render his peculiar talents and equipment in the production of several films. In the lurid, low-budget horror picture entitled DRACULA VS.





Two shots of the fabulous Strickfaden-designed laboratory in FRANKENSTEIN. Much of this equipment was used later in THE BRIDE OF FRANKENSTEIN (1935) and more recently in Mel Brooks' YOUNG FRANKENSTEIN.



Fu Manchu wields the sword of Genghis Khan.

FRANKENSTEIN (Independent-International—1971) he created some fresh special effects involving a magical lightning ray ring worn by Dracula. A few years later he allowed his original Frankenstein equipment to be used again for the laboratory scenes in the Mel Brooks' comedy, YOUNG FRANKENSTEIN (20th Fox-1974).

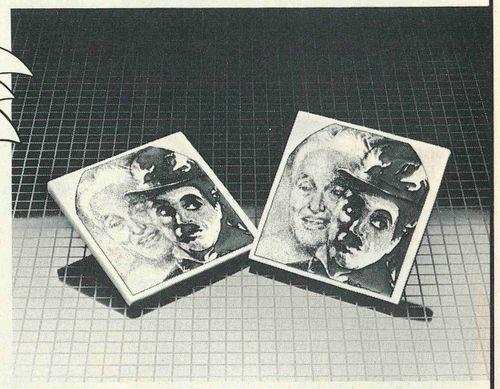
Recently it was learned that Ken Strickfaden had moved and changed his telephone number. People had been calling and writing to him from all over the country asking him if he wanted to get rid of his machines. This is probably insulting to him since he must obviously cherish these gadgets (as well as his privacy).

The kind of films that incorporated strange electrical effects always made a difficult job for a technician like Strickfaden. These films called for authentic apparatus that would perform sensational displays usually possible only in large electrical research labs furnished with expensive equipment. Not all the gadgets seen in these movies, however, were required to work — many of them just sat around filling in space and looked atmospherically impressive. Strickfaden was expected to have in stock a wide array of every kind of apparatus that might be needed. If he did not have it he would go home to Santa Monica and build it overnight. Many pieces of apparatus were used over and over again in different films, sometimes slightly altered or disguised. Quite a few of these pieces were originally used in the 1931 FRANKENSTEIN picture. Strickfaden did have names for some of these things such as the "DXL Accumulator", "Lightning Screen", "Dynascope", "Retrogressive Wave Charger", and the "High Amperage Pyrogeyser". And they've all glowed, pulsated, hummed, crackled, and sparked their way into the hearts of millions of movie fans for over the last half century.

William Ludington lives in Silver Spring, Maryland.

LIMITED EDITION MARBLE ART

$12.95 each set of four $40.00



INDIVIDUALLY PACKAGED

ACTUAL SIZE:
4 x 4 x ½

No one face is more symbolic of Hollywood or the movies than that of the legendary Charlie Chaplin. This handsome rendering (from an original ***ACS*** cover painting by John Tibbetts) is finely engraved on white marble and is of a limited edition of 100. The mold *has been* destroyed and there will be no more cast!

The classic etching captures Chaplin as a young and old man and is truly a versatile collector's piece. It may be framed for use as a handsome wall decoration or used as a coaster, desk ornament or wonderful conversation piece for your coffee table or book case.

It is the first in a series of ***ACS*** limited editions and is a classy and eye-catching gift or personal item. . . your way of saying "I love the movies."

NAME: _____

ADDRESS: _____

CITY/STATE/ZIP:_____

Please send me _____ limited edition Chaplin renderings at $12.95 each or _____ set(s) at $40.00. (Orders will be filled by postmark dates while supply lasts.)

Check One:
☐ My check is enclosed
☐ Charge to MasterCard
☐ Charge to Visa
Credit Card No. _____
Expiration Date: _____

Make checks payable and return to:
American Classic Screen
8340 Mission Rd., Suite 106
Shawnee Mission, KS 66206

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

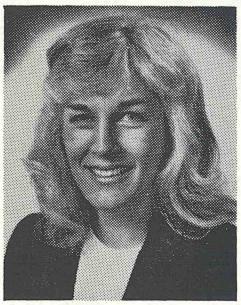
Monrovia Management Association
MCDONNELL DOUGLAS
MMA
the Scribe

Volume 12, Issue 1 | Monrovia, California | January 1993

President's Corner

by Karen Dalton

Happy New Year to all! On behalf of the Executive Board, I thank you, the members, for your vote of confidence.



Having served the MMA in many capacities for the past 7 years, I know we have a big responsibility to uphold our positions with honor, integrity and in the best interest of the club, its members, and the community.

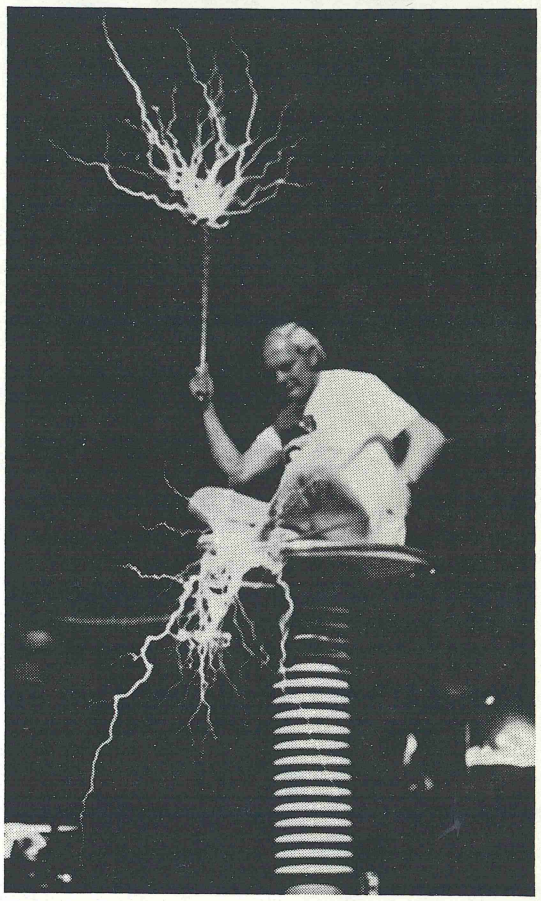
1992 was just such a year. Ron Larson and his MMA team are to be congratulated. As I perused the monthly Scribes, so professionally managed by Marge Randle, I was reminded of the dedication and plain hard work it takes behind the scenes for the dinner meetings, reception, seminars, programs, and Teammate of the Month. All of the club's philanthropic programs such as Scholarships, Students of the Month, Adopt-A-School, and Project Love are strong and healthy. I was thrilled to hear that six new volunteers accompanied Project Love veterans Betty Smith and Gary Hosteller on the trek to Navajo Mountain. To all employees who donated gifts, clothing, and the most precious, their time, thank you. It truly is a project of love met with deep gratitude from the Navajo community.

(continued on page 4)

January Speaker

Bill Wysock

"Tesla Coil Presentation and Demonstration"



Bill is the owner and founder of Tesla Technology Research, which was founded in 1975. The company specializes in the design, construction, and sales of laboratory grade Tesla Coil systems and components, with specialization markets in museums of science and industry, government and private research organizations, private experimenters, motion pictures, television, graphics, and exhibition special effects and events. The Tesla Coil is named for Nikola Tesla, an inventor who was a contemporary of Edison and Marconi. Tesla's singular important area of investigative study was in the field of high frequency/high voltage phenomena, and the Tesla Coil is his most widely known invention. This device is the basis for all radio and modern communications. A "hybrid" version of his famous transformer resides in the power supply of every device using a cathode ray tube (CRT), including every computer monitor and every television set. Bill will present an overview of the Tesla Coil, and a live demonstration of this most significant and fundamental device.

MORE INSIDE

Christmas Party Pictures 2/3
Christmas Party Prize Winners 4
New Members 4
MMA Executive Board for 1993 4
In Memory of Art Wehry 4

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Technical Addendum

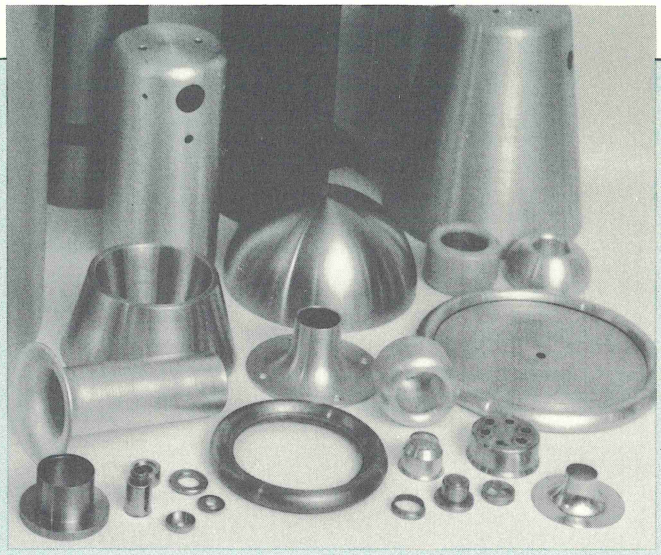
Tesla Coil Data:

Voltage	500kv
Spark Length	85 cm
Frequency	650kHz
Power	1-2kva

1) The coil was built and first demonstrated (as shown) in 1948 by R. G. Aurandt.
2) The entire outfit (coil, transformer, rotary spark gap, capacitor and control system) was, in 1965, given to Edwin M. Winet; a close friend of the builder and Tesla Enthusiast.
3) In early 1981, the coil without its sundry components was purchased from Mr. Winet by William C. Wysock.
4) This photograph was taken by Mr. Wysock, at his residence in March 1981 in preparation for providing the effect needed in the making of a new motion picture, "The Entity."

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

QUALITY ASSURANCE



OUR QUALITY MANAGEMENT PROGRAM BEING IMPLEMENTED

It is our quality policy to supply to our customers parts manufactured by O.W. Landergren, Inc. complete with all paper work, on time delivery, and "Defect Free." This is done by stressing the importance of teamwork and dignity of the individual worker and the importance of each member of the work force and their desire to adhere to the contracting company's needs and requirements.

Quality planning starts at the time of quotation by getting our concerns and customer's requirements defined. Management sets up operational processes to be followed with characteristics that are most promising for improvement and targets potential problem areas. Any deviations needed for manufacturing are noted on quotation request as exceptions.

Employee contribution is an integrated part for the success of the manufacturing procedures made out by senior management (called a routing sheet). This routing sheet is used as a guideline throughout the manufacturing process. Employees are encouraged to add their own notes to the routing sheet for future references or changes that they feel will be beneficial to achieve a better quality part. These changes will be reviewed by our material review board, making the decision to add suggested procedures to the routing sheets. To support this value, we believe that there is no best way to manufacture any part or run any procedure— there are only better ways.

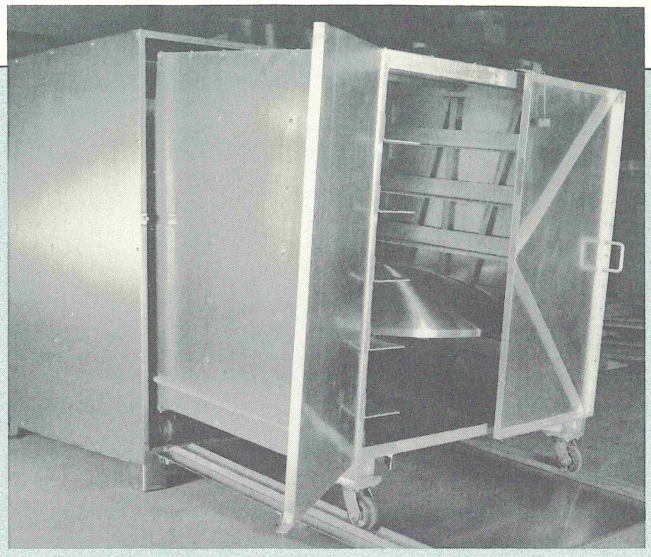
Because our company is not a standard within the manufacturing industry, due to short runs and quality requirements from our customers, we have developed a precise way to identify opportunities. This is done by on-site evaluation, through operator control, correlated to the manufacturing process taking place. This process enables us to put the responsibility of quality control where it belongs, in manufacturing, making it possible to concentrate on prevention, rather than running around putting out fires. Group leaders in each section, working hand in hand, play a vital roll in the success of this approach to quality, so no procedural change will take place that will interfere with any other operational procedure performed throughout the manufacturing process.

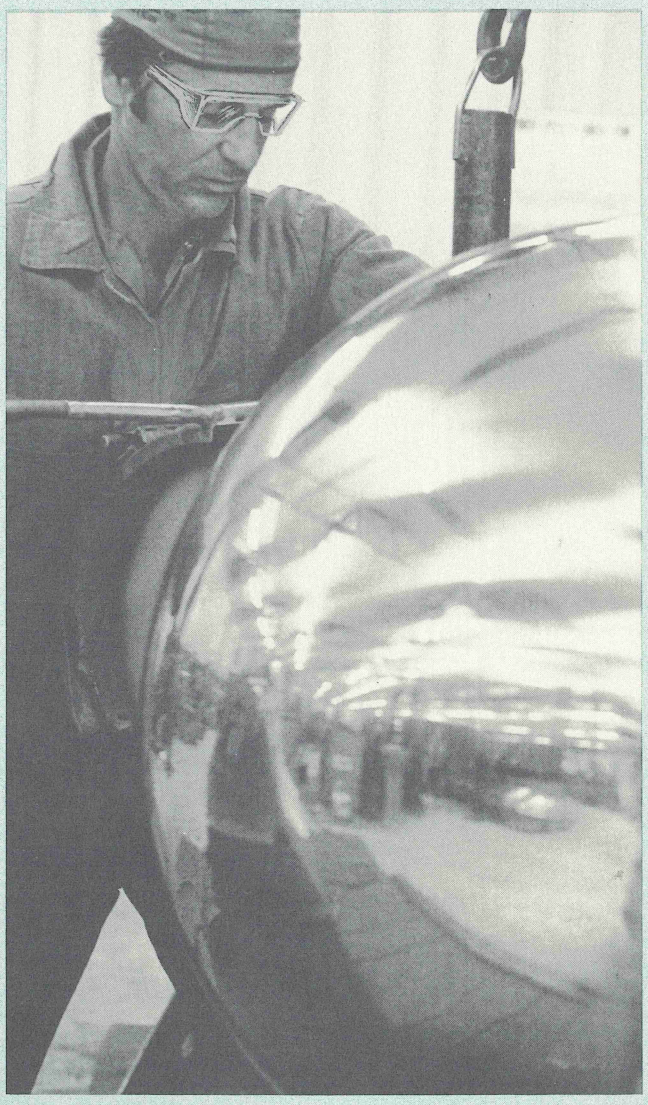
Metal Spinning • Metal Fabricating & Welding • General Machining
1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

O.W. LANDERGREN, INC.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PRODUCTS MANUFACTURED
INDUSTRIES SERVED



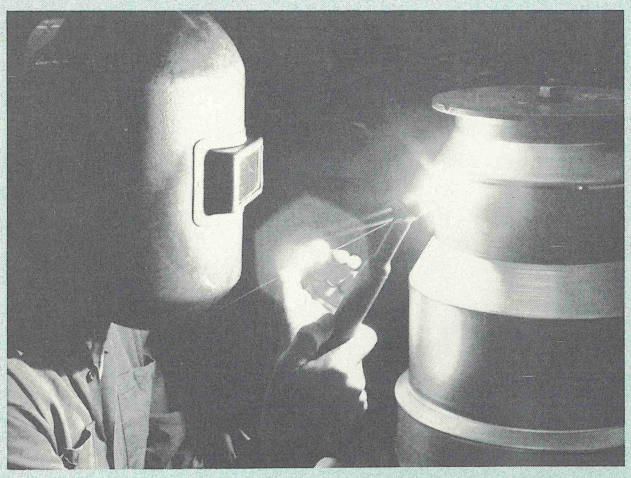


PRODUCTS

Corona Shields, Toroids, Static Shields & Spheres, Metal Components of High Temperature Alloys, Missile Components, such as Nose Cones, Tail Cones, and Sub-Assemblies used in Aircraft Refueling Systems. Spun Housings used for Airport Lighting Equipment. Centrifuge Components, such as Windshields and Covers used for Blood Analysis Equipment, for the Medical Field. Components used in Power Tube Assemblies, Evaporation Domes used in Computer Chip Manufacturing. Cooling Chambers, Screens & Filters used in Paper Manufacturing. Jet Assemblies, Defusers, Cold Caps, and Baffles used in the Vacuum Industry. Fabrication of Metal Cabinets, Frames, Guards and Control Panels.

INDUSTRIES SERVED

Electrical & Power, Government, Computer, Religious Goods, Vacuum, Aerospace, Mechanical, Architectural/Ornamental, Medical/Research, Agricultural & Environmental.



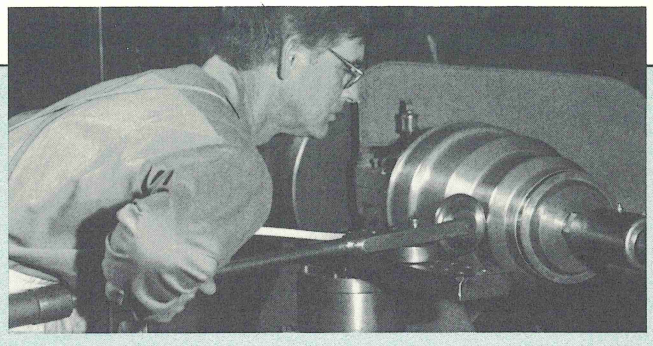
Metal Spinning • Metal Fabricating & Welding • General Machining

1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

O.W. LANDERGREN, INC.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

DESIGN TIPS
FOR METAL SPINNING



Dimensions

Prefer to have inner diameter dimension and their tolerance, if outer diameter dimension is given-consider an average of 25% to 30% material thinout. This is typical.

Material Thickness

Sidewalls thin depending on type of material, height of sidewall required and how much pressure is needed to form raw material to mandrel. Sidewalls will vary typically 25%.

Avoid sharp corners. Formed radius should be specified as no **less** than 2-3 times the material thickness if possible. The radius in corners can equal the metal thickness in some situations. Secondary machining can sharpen radius if necessary, however this will weaken the corner. Corners and radius will vary typically 30%. The thickness of the bottom will be the thickness of the original blank.

Tolerances

Don't overspecify tolerances. If a uniform wall thickness is critical, be sure to specify it on the drawing. Secondary machining may be necessary. If you need a specific thickness or dimension on a part of a sidewall, don't specify it on the whole part. Be sure to specify critical points with tolerances, don't just give overall tolerances on the print. The tolerance you specify dictates where emphasis will be placed when tooling is developed. Be sure to evaluate the cost versus tolerance - Tighter tolerance increases cost.

What Tolerances Can Be Held

In some cases a +–.005 is possible on parts under one foot in diameter. From 12" to 24" inside diameter a normal tolerance should be +–.010, 2 to 4 feet +–.020 and 4 to 8 feet +–.030. Roundness, parrellelism, flatness, perpendicularity is directly related to the diameter, part configuration, Type and thickness of material part is manufactured from. A tolerance of .010 for every foot in diameter can be obtained in most cases.

IMPORTANT- Any secondary work that is required on any given part such as drilling, milling and welding will effect the tolerance that can be maintained. The Engineer should state whether measurement is to be restrained or unrestrained.

Geometrics

Symmetrical shapes are normal, however, parts can be sectioned to achieve a wide variety of geometric shapes. Conical, hemispherical, cylindrical, re-entrant, parabolic, venturi, flanged and dished shapes are specialties.

Materials

Any formable alloy or metal can be spun. Especially any material that can be formed by deep drawing or formed on a press, hydroformed or formed by fabricating on a press brake.

The Size

Spun parts can range from a fraction of an inch up to ten feet in diameter. The thickness of materials range from .015 to .190 in most materials. Part configuration determines material thickness our machinery can handle.

Cost Factors

This plays a major role in the success in manufacturing by way of metal spinning. Tools cost less due to its simplicity. Being machined from steel, tool steel, case hardened steel and for shorter runs and proto-types in most cases composite materials can be used. Delivery is quicker due to ease of tooling, therefore lead times are shorter. Ease of design changes lower overall cost from proto-typing through production. NOTE: Most tool dimensions can be made smaller at any time.

The metal spinning process actually improves the raw material metallurgical by re-aligning grain structures. Tensile strength can be improved, allowing thinner materials to be used. Overall part integrity is actually better with spinning than any other process.

Metal spinning is a process performed by highly skilled craftsmen using a blank which rotates between a chuck or mandrel and a clamped tail stock of a spinning lathe. The blank is formed with spinning rollers, with ample pressure applied by the spinner, the blank is formed over the chuck with the dimensions of tool (mandrel) corresponding to the inside dimensions of the part being formed.

Each job stands on its own merit, if tolerances are tight, tooling may cost more, or secondary machining operations may be performed. The Designer/Engineer should specify what is needed.

Please feel free to contact O. W. Landergren with any questions regarding the above information.

Metal Spinning • Metal Fabricating & Welding • General Machining

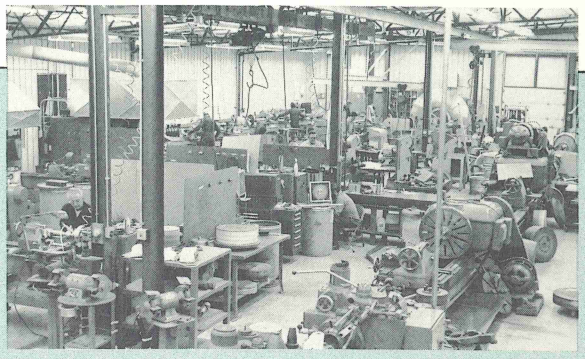
1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

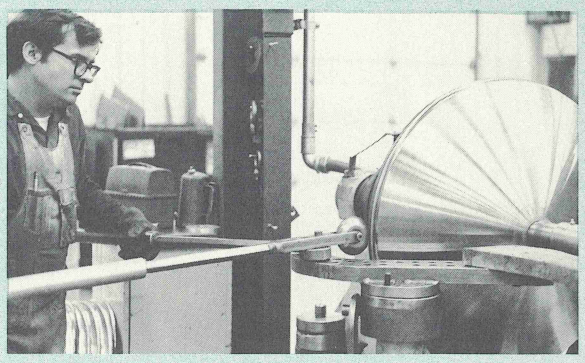
O.W. LANDERGREN, INC.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

FACILITIES

Landergren's primary functions are metal spinning and fabricating with complete facilities for general machine work, plus the equipment for assemblies of prototype, low production, military and commercial jobs. Our operation enables us to carry most jobs through to completion without leaving our building.





Metal Spinning Equipment

13 Spinning Lathes
Capacity from 18" to 132" swing; also hydraulic assist equipment for heavier gauge material.

Other Machine Shop Equipment

1 46" Diameter Swing Machine Lathe
14 Machine Lathes
10" to 36" diameter swing, plus a 19" tracer lathe.
1 Vertical Cincinatti #3 Miller
1 Vertical Bridgeport Miller Series III
5 Vertical Bridgeport Millers #12/BJR
1 Vertical Lagun Miller
2 Horizontal Millers
1 Hurco CNC Milling Machine
1 Brown & Sharpe Surface Grinder
4 Punch Presses - 15 to 70 ton capacity
1 Hydraulic Arbor Press - 10 ton
1 Vertical Hydraulic Press - 70 ton
12 Drill Presses - 1 Niagara 3 ft. Shear
1 Niagara 10 ft. Power Shear
5 Niagara & Pexto Ring & Circle Shears
1 Plasma Metal Cutting Machine
1 Friction Cut-Off Saw - 1 Band Saw
1 Dual Buffer - 2 Belt Grinders
2 Power Hack Saws
1 6 ft. Hand Brake - 1 8 ft. Hand Brake
1 10 ft. Power Press Brake
4 Sets Rolls - 2 Riveters
1 Pierce-All Perf-O-Mator Hole Punch Machine
1 Pierce-All 50 ton Perf-O-Mator
1 Hydraulic Notching Machine
1 Power Sheet Burring Machine
1 12" dia. x 18" High Capacity Vacuum Furnace

Heat Treating and Annealing Equipment

1 20" x 20" x 48" Heavy Duty Electric Furnace with Recorder
1 14" x 14" x 20" High Temperature Gas Furnace

Welding Equipment

6 Tig Heli-Welders 300 KVA
2 Mig Production Welders 300 KVA
1 3 ft. Seam Welder
4 Welding Positioners
4 Acorn Welding Tables
2 Spotwelders - 15 KVA & 25 KVA

Metal Finishing Equipment

1 Set Aluminum Cleaning Tanks
1 Complete set of tanks for chromating aluminum

Inspection Equipment

1 Inspection room equipped with granite surface plates and all the necessary measuring tools and gauges to provide first piece, in process and final inspection. Our limit of Quality Control is determined by customers' requirements to commercial or military standards.

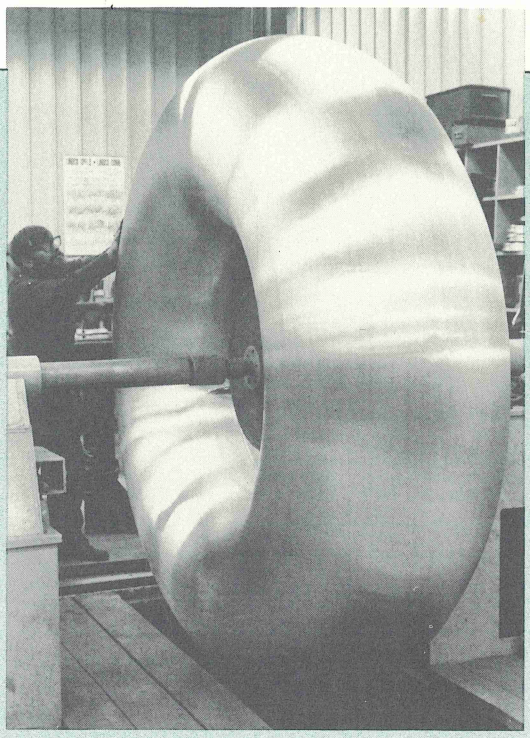
Metal Spinning • Metal Fabricating & Welding • General Machining
1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

O.W. LANDERGREN, INC.

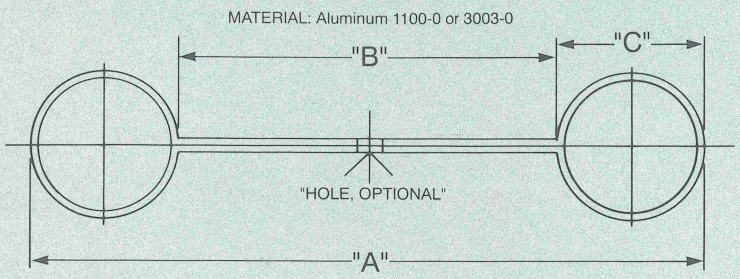
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

EXISTING TOOLING

TOROIDS & CORONA SHIELDS



Corona Ring Tooling On Hand



" A" DIM	"B" DIM	"C" DIM
3"	2.500"	.250"
4"	3"	.500"
4"	2"	1"
6"	5"	.500"
7"	3.500"	1.750"
7.375"	6.375"	.500"
7.375"	6.120"	.630"
8"	4"	2"
8"	6"	1"
8.250"	7.250"	.500"
9.250"	7.250"	1"
10"	5"	2.500"
10"	8.500"	.750"
10"	6"	2"
10"	8.500"	.750"
12"	7"	2"
12"	8"	2"
12"	8.500"	1.750"
12"	10"	1"
12.500"	9.500"	1.500"
14"	12"	1"
14"	10"	2"
14"	6"	4"
14"	7"	3.500"
15"	11""	2"
16"	12"	2"
16"	6"	5"
16.500"	12.500"	2"
18"	9"	4.500"

" A" DIM	"B" DIM	"C" DIM
18"	12"	3"
18.125"	14.125"	2"
19"	10"	4.500"
19"	16"	1.500"
20"	6"	7"
20"	10"	5"
20"	14"	3"
20.250"	16"	.125"
20.250"	12.250"	4"
20.500"	18.500"	1"
22"	18"	2"
24"	12"	6"
24"	19"	2.500"
24"	14"	5"
25"	21"	4"
25.500"	21.500"	2"
28"	14"	7"
30"	12"	9"
30"	16"	7"
30.500"	24.500"	3"
34"	17"	8.500"
36"	30"	3"
36"	24"	6"
36"	16"	10"
38"	18"	10"
40"	28"	6"
40"	20"	10"
41"	29"	6"

" A" DIM	"B" DIM	"C" DIM
42"	22"	10"
43.250"	19.750"	11.750"
46.250"	36.250"	5"
47"	39"	4"
48"	42"	3"
48"	40"	4"
48"	36"	6"
48"	24"	12"
48"	33"	7.500"
50"	18"	16"
52"	44"	4"
52"	40"	6"
56"	28"	14"
57"	47"	5"
58"	34"	12"
59"	49"	5"
59"	31.500"	13.750"
61"	39.500"	10.750"
68"	40"	14"
68.500"	32"	18.250"
74.625"	58.625"	8"
76"	54.500"	10.750"
88"	64"	12"
96"	36"	30"
98"	70"	14"

Metal Spinning • Metal Fabricating & Welding • General Machining

1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

O.W. LANDERGREN, INC.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

General Machine Work | Fabrication | Heli - Welding | Development Work

O. W. Landergren, Inc.

METAL SPINNING

1500 WEST HOUSATONIC STREET | TELEPHONE (413) 442-5632 or 445-5604 | PITTSFIELD, MASS. 01201
FAX (413) 499-0614

EXISTING TOOLS FOR HEMISPHERES OR SPHERES

Tooling Diameter	Tooling Type	Tooling Diameter	Tooling Type	Tooling Diameter	Tooling Type
.675	steel	4.830	steel	10.47	wood
1.365	steel	4.875	steel	10.94	wood
1.510	steel	4.895	steel	11.55	wood
1.630	steel	4.920	steel	11.74	wood
1.665	steel	4.925	alum.	11.82	wood
1.755	steel	4.930	steel	11.88	wood
1.895	steel	5.000	steel	11.90	wood
2.150	steel	5.410	steel	11.98	wood
2.380	steel	5.555	steel	12.51	wood
2.410	steel	5.775	alum.	12.86	wood
2.425	steel	5.870	steel	13.47	wood
2.585	steel	5.880	steel	14.00	wood
2.620	steel	5.890	steel	14.50	alum.
2.725	steel	5.915	steel	14.50	wood
2.765	steel	6.000	steel	14.93	wood
2.865	steel	6.370	steel	15.84	wood
2.885	steel	6.405	steel	16.09	wood
2.900	steel	6.585	steel	19.31	steel
3.295	steel	6.785	steel	19.75	wood
3.375	steel	7.010	steel	20.00	wood
3.400	steel	7.150	wood	20.02	wood
3.410	steel	7.605	wood	20.37	wood
3.590	steel	7.860	steel	23.75	wood
3.615	steel	7.880	steel	29.33	wood
3.750	steel	7.900	steel	29.75	wood
3.820	steel	8.000	steel	31.72	wood
3.865	steel	8.040	wood	35.81	wood
3.870	steel	8.850	steel	39.04	wood
3.880	steel	9.000	wood	58.37	wood
4.000	steel	9.020	wood	60.00	wood
4.265	steel	9.625	steel	65.62	wood
4.625	steel	9.630	wood		
4.775	alum.	9.705	steel		
4.810	steel	9.725	steel		

NOTE: dimensions listed are inside dimensions

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Tesla Technology Research

Manufacturer of the Worlds Largest Tesla Coil Systems - Over 200 Units Worldwide

est. 1975

Magnifier Systems to 25 Million Volts Coils for Research Industry, Display

2527 Treelane Ave.
Monrovia, CA 91016-2985
(818) 359-1373 Voice
(818) 307-4215 FAX

William C. Wysock, President
Member: Tesla Builders Assn.
International Tesla Society

Model 12 Dual Tesla Coil - 6.5 Million Volts - Colorado Springs - July 1992

MODEL 14 MAGNIFIER TESLA COIL SYSTEM PROSPECTUS

I. PROJECT DEFINITION.

II. PROJECT OBJECTIVES.

III. PROJECT APPLICATIONS.

IV. PROJECT ITINERARY.

V. PROJECT MATERIAL REQUIREMENTS.

VI. ESTIMATED MATERIAL COST.

VII. ESTIMATED LABOR COST.

VIII. PROJECT FUNDING RESPONSIBILITY.

IX. RETURNS ON INVESTMENTS.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PROJECT DEFINITION.

THE MODEL 14 MAGNIFIER TESLA COIL SYSTEM IS A RELATIVELY COMPACT AND PORTABLE VERY HIGH POWER AND EXTREMELY HIGH VOLTAGE RADIO-FREQUENCY RESONANCE POWER SUPPLY, ADAPTABLE TO A WIDE VARIETY OF APPLICATIONS. IT WILL COMPRISE THE LARGEST HIGH FREQUENCY RESONATE POWER SOURCE EVER TO BE MADE AVAILABLE.

PROJECT OBJECTIVES.

* GENERATE INDUSTRY AND PUBLIC INTEREST IN, AND AWARENESS OF, TESLA TECHNOLOGY RESEARCH; CREATE SALES OPPORTUNITIES FOR THIS SYSTEM AS WELL AS OTHER RELATED EQUIPMENT AND SERVICES AVAILABLE FROM TESLA TECHNOLOGY RESEARCH.

* EXHIBIT THE MODEL 14 MAGNIFIER SYSTEM AT THE SIXTH BI-ANNUAL INTERNATIONAL TESLA SOCIETY SYMPOSIUM IN COLORADO SPRINGS, COLORADO, ON JULY 22-24, 1994.

* TAKE ADVANTAGE OF THIS SYMPOSIUM AS A HISTORY-MAKING EVENT OPPORTUNITY, SETTING A NEW WORLD-RECORD PRECEDENT FOR A PUBLIC DEMONSTRATION, AND THE ATTENDANT PUBLICITY THAT WILL FOLLOW.

* GENERATE A POWER OUTPUT WITH THIS SYSTEM GREATER THEN 20,000,000 VOLTS AND ELECTRICAL DISCHARGES GREATER THEN 75 FEET IN LENGTH.

* PROVE PERFORMANCE BY DEMONSTRATION, OF A NOVEL MODERN DESIGN APPROCH IN THE CONSTRUCTION OF AN EFFICIENT APPARATUS FOR THE GENERATION OF EXTREMELY HIGH VOLTAGE AND FREQUENCY.

* ATTEMPT TO ATTRACT NATURAL LIGHTNING DURING THE DEMONSTRATION AT COLORADO SPRINGS, IF FAVORABLE WEATHER CONDITIONS PREVAIL. (THIS WOULD BE A HISTORY-MAKING FIRST.)

PROJCET APPLICATIONS.

* SHOW TOUR CONTRACTS FOR PUBLIC DEMONSTRATIONS, LECTURES AND SYMPOSIA.

* SPECIAL EFFECTS FOR MULTI-MEDIA; MOTION PICTURES, TELEVISION AND VIDEO PRODUCTIONS, ADVERTISING AND SPECIAL EVENT ASSIGNMENTS.

* RESEARCH TOOL WITH APPLICATIONS TO INDUSTRY AND GOVERNMENT RESEARCH.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PROJECT ITINERARY.

MARCH 31 - ALL NECESSARY FUNDS FOR MATERIAL PURCHASES AND ANTICIPATED LABOR COSTS SECURED.

APRIL 1-11 - ALL ORDERS FOR OUTSIDE SOURCE MATERIALS PLACED.
SITE SELECTION FOR CONSTRUCTION AND TESTING SECURED.
BEGIN CONSTRUCTION OF SYSTEM, BASED ON ITEMS AVAILABLE.

MAY 30 - ALL ORDERED MATERIAL RECEIVED AT CONSTRUCTION SITE.

JULY 2 - ALL CONSTRUCTION FINISHED. TESTING OF SYSTEM BEGINS.

JULY 9 - ALL TESTING AND DOCUMENTATION COMPLETED.

JULY 11-12 - SYSTEM DISMANTLED; PACKAGED FOR SHIPMENT BY TRUCK TO COLORADO SPRINGS.

JULY 18 - SYSTEM ARRIVES AT COLORADO SPRINGS; SETUP BEGINS.

JULY 22 - SYSTEM READY FOR FINAL TEST AND PUBLIC DEMONSTRATION.

JULY 24-26 - SYTEM DISMANTLED; PACKAGED FOR SHIPMENT BY TRUCK TO LOS ANGELES.

AUGUST 1 - SYSTEM ARRIVES IN LOS ANGELES; EITHER TO BE PLACED IN STORAGE OR SET UP FOR FUTURE ASSIGNMENT(S).

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PROJECT MATERIAL REQUIREMENTS.

* 360 LINEAR FEET OF FIBERGLAS 3 INCH BY 1.5 INCH "T" EXTRUSION STOCK.

* 330 LINEAR FEET OF FIBERGLAS 6 INCH BY 3 INCH "C" EXTRUSION STOCK.

* 12 EACH 10 FOOT BY 12 INCH O.D. PVC FUME DUCT.

* 60 SQUARE FEET OF 3/4 INCH THICK PVC SHEET STOCK.

* 1 EACH 96 INCH DIAMETER ALUMINUM HOLLOW-SPUN TOROID DISCHARGE ELECTODE.

* 2 EACH 72 INCH DIAMETER ALUMINUM HOLLOW-SPUN TOROID DISCHARGE ELECTODES.

* 60 FEET OF 10 INCH DIAMETER THIN WALL FLEXIBLE SPIRAL-LOCK STEEL TUBING.

* 60 FEET OF 6 INCH DIAMETER THIN WALL FLEXIBLE SPIRAL-LOCK STEEL TUBING.

* 36 FEET OF 6 INCH DIAMETER THIN WALL RIGID STEEL TUBING.

* 100 FEET OF 6 INCH BY 4 INCH STEEL "I" BEAM STOCK.

* 16 EACH HEAVY-DUTY STEEL SWIVEL LOCKING CASTORS.

* 6,300 FEET OF #4 A.W.G. THN FINE STRAND COPPER CABLE, (3,700 FEET ON ONE WOOD SPOOL, 2,600 FEET ON ANOTHER; BOTH ONE PIECE UNBROKEN.)

* 180 FEET OF 500 MCM FINE-STRAND WELDING CABLE.

* 1 EACH 10 HP, 3,450 RPM, 3-PHASE 240 VOLT INDUCTION START/RUN MOTOR.

* MISCELLANEOUS: 600 AMP MAIN POWER BREAKER, METERS AND POTENTIAL/CURRENT TRANSFORMERS, POWER RELAY CONTACTORS, WARNING LIGHTS, VARIACS, HOOK-UP CABLING AND BUSS BARS, VARIOUS HARDWARE.

* 150 KVA, 3-PHASE 240 VOLT DIESEL MOTOR/GENERATOR (RENTAL FOR CONSTRUCTION AND TEST SITE ONLY.)

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

ESTIMATED MATERIAL COST.

* THE CURRENT PROJECTION FOR ALL MATERIAL PROCUREMENT IS BELIEVED NOT TO EXCEED $20,000.00, ACTUAL COSTS STILL TO BE VARIFIED.

* THE RENTAL OF A DIESEL MOTOR/GENERATOR SET FOR TESTING PURPOSES IS NOT EXPECTED TO EXCEED TWO WEEKS DURATION.

ESTIMATED LABOR COST.

* PRELIMINARY ESTIMATED TOTAL LABOR EFFORT FOR CONSTRUCTION AND TESTING OF THE MODEL 14 MAGNIFIER TESLA COIL SYSTEM IS CALCULATED AS 500 HOURS.

* BASED ON A TWO-MAN TEAM, WORKING APPROXIMATELY 40 HOURS/WEEK, AT THE CONTRACT CASUAL LABOR RATE OF $15.00/HOUR/PERSON, TOTAL LABOR COST SHOULD NOT EXCEED $15,000.00.

PROJECT FUNDING RESPONSIBILITY.

I. TESLA TECHNOLOGY RESEARCH SHALL PROVIDE ALL EXISTING MATERIALS AND AVAILABLE LABOR TOWARDS THIS PROJECT, INCLUDING DESIGN, CONSTRUCTION, TESTING AND PACKAGING FOR SHIPMENT. $35,000.00 SUPPORT FUNDING IS REQUIRED TO MEET THIS GOAL. TTR SHALL ALSO PROVIDE PRIMARY TECHNICAL OPERATIONS PERSONNEL.

II. THE INTERNATIONAL TESLA SOCIETY SHALL BE RESPONSIBILE FOR THE FOLLOWING:

* ROUND-TRIP TRANSPORTATION TO AND FROM COLORADO SPRINGS, INCLUDING ALL SHIPPING AND SHOW EVENT LIABILITY INSURANCE FOR ALL EQUIPMENT AND PERSONNEL, ON-SITE ADDITIONAL TECHNICAL ASSISTANCE (INCLUDING SECURITY AND ADMINISTRATIVE SUPPORT.) ALL ON-SITE PUBLIC RELATIONS AND MASS-MEDIA PUBLICITY, HEAVY EQUIPMENT RENTALS AND OPERATORS, AND ALL ON-SITE SUPPORT EQUIPMENT (INCLUDING A 150 KVA DIESEL MOTOR/GENERATOR.)

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

RETURNS ON INVESTMENTS.

* R.O.I., BASED UPON SALE OF THE MODEL 14 MAGNIFIER TESLA COIL SYSTEM.

  WITHIN 12 MONTHS OF PROJECT COMPLETION - 15%

  WITHIN 24 MONTHS OF PROJECT COMPLETION - 20%

  WITHIN 36 MONTHS OF PROJECT COMPLETION - 30%

* THE ABOVE R.O.I. AMOUNTS ARE NEGOTIABLE.

* MODEL 14 MAGNIFIER SYSTEM RENTAL/LEASE OPPORTUNITIES IN LEU OF SYSTEM SALE. ALL RENTAL FEES COLLECTED SHALL BE PAID OUT AS R.O.I., MINUS ACTUAL OPERATING EXPENSES PER EVENT, UNTIL TOTAL RETURN MATCHES THAT OF SALE CONDITIONS ABOVE.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O. W. Landergren, Inc.

METAL SPINNING

1500 W. HOUSATONIC ST. • PITTSFIELD, MASS. 01201 • PHONE 442-5632 & 445-5604
FAX 499-0614

QUOTATION

Tesla Tech Res.
2527 Treelane Ave.
Monrovia, CA 91016

Attn: Bill Wysock

DATE 2/15/94

GENERAL MACHINE WORK
FABRICATION
HELI-WELDING
DEVELOPMENT WORK

REFERENCE:

Recent request for quotation

QUANTITY	DESCRIPTION	PRICE	DELIVERY DATE
1 pc.	Aluminum Toroid 96" x 36" x 30"	$3,700.00 ea.	Approx. 6-10 wks
2 pcs.	Aluminum Toroid 76" x 54 1/2" x 10 3/4"	1,750.00 ea.	ARO
	NOTE: Prices include wood shipping box.		
TOOLING			

TERMS: NET 30 DAYS

TOTAL

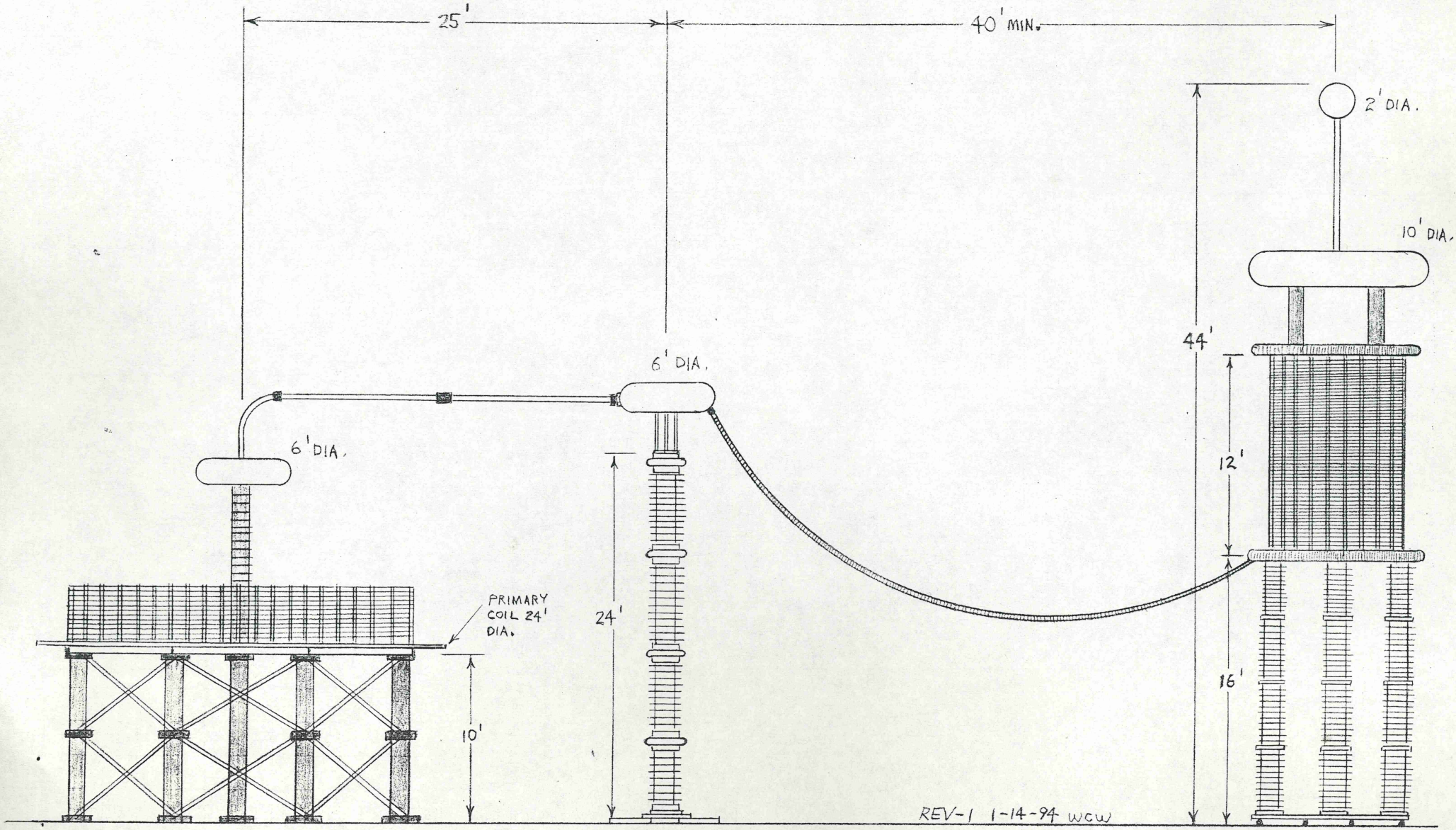
F.O.B. Pittsfield, MA

O. W. LANDERGREN, INC.

SIGNED BY Mark R Pratt

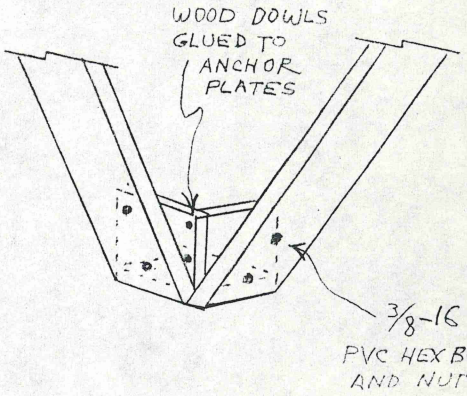
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

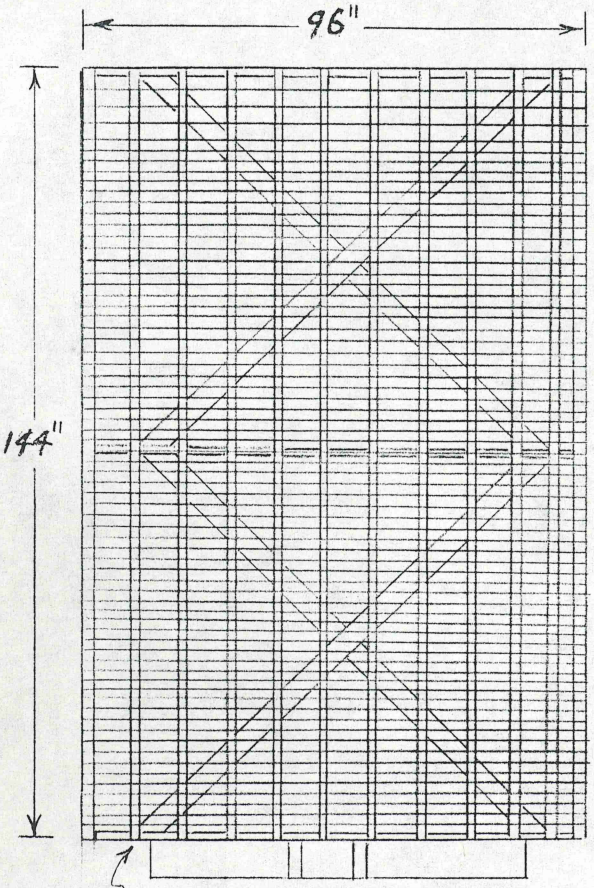
TESLA TECHNOLOGY RESEARCH
MODEL 14
MAGNIFIER SYSTEM



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 TESLA COIL MAGNIFIER SYSTEM
EXTRA COIL DETAIL

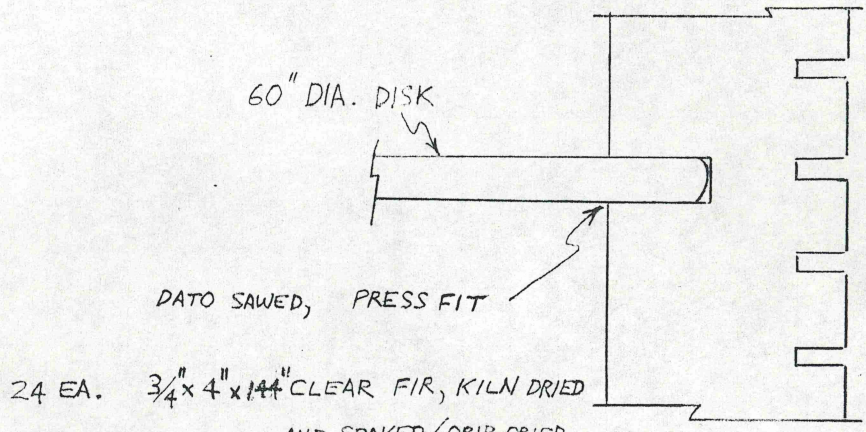




24 EA. VERTICAL SLATS, EVERY 7 7/8" ON CENTER

EXTRA COIL 100 TURNS = 2,513'
D = 96"

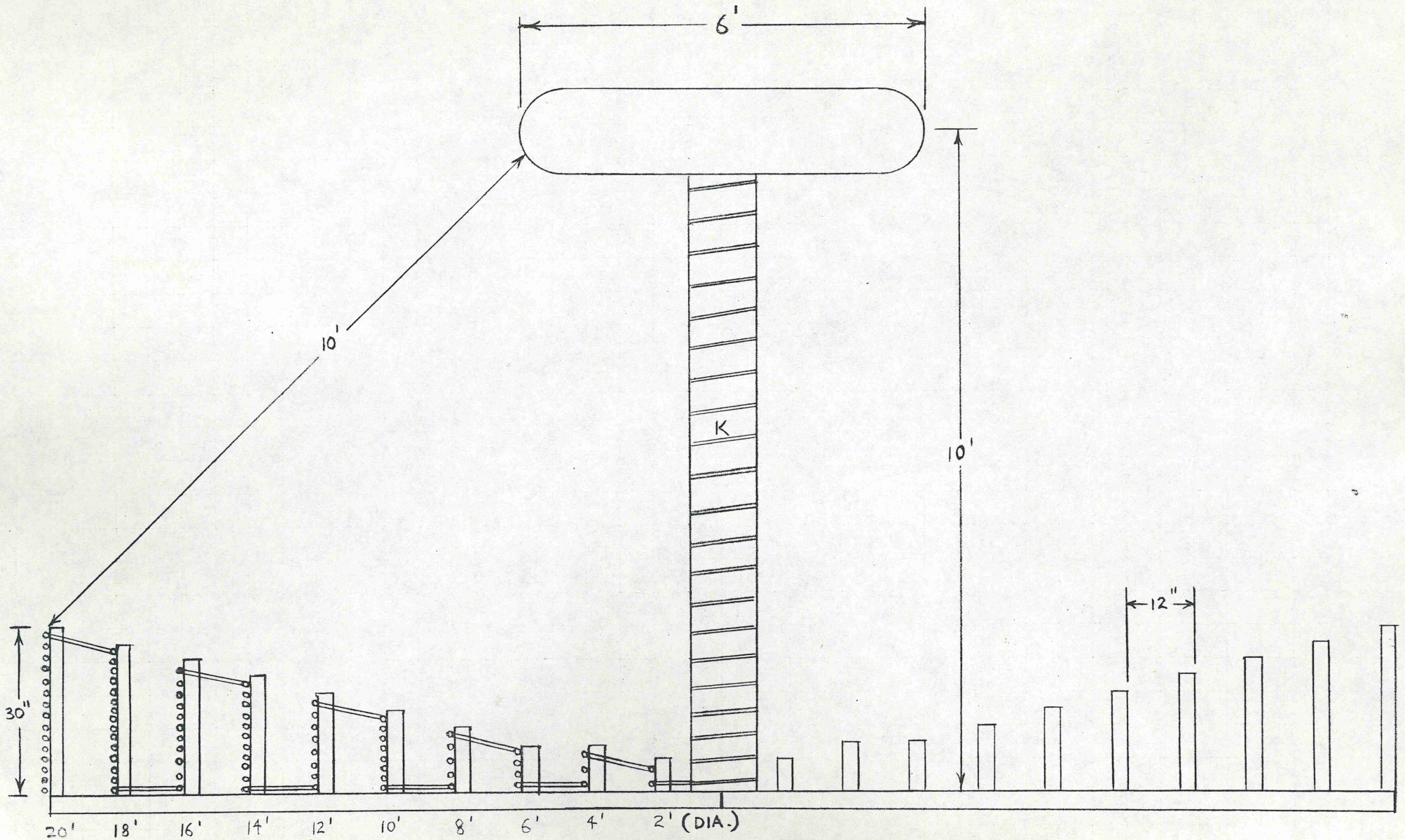
SECONDARY COIL 10 LAYERS = 3,695'
D = 20'



24 EA. 3/4" x 4" x 144" CLEAR FIR, KILN DRIED AND SOAKED/DRIP DRIED WITH THOMPSON'S WATER SEAL.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER TESLA COIL: 1ST SECONDARY WINDING



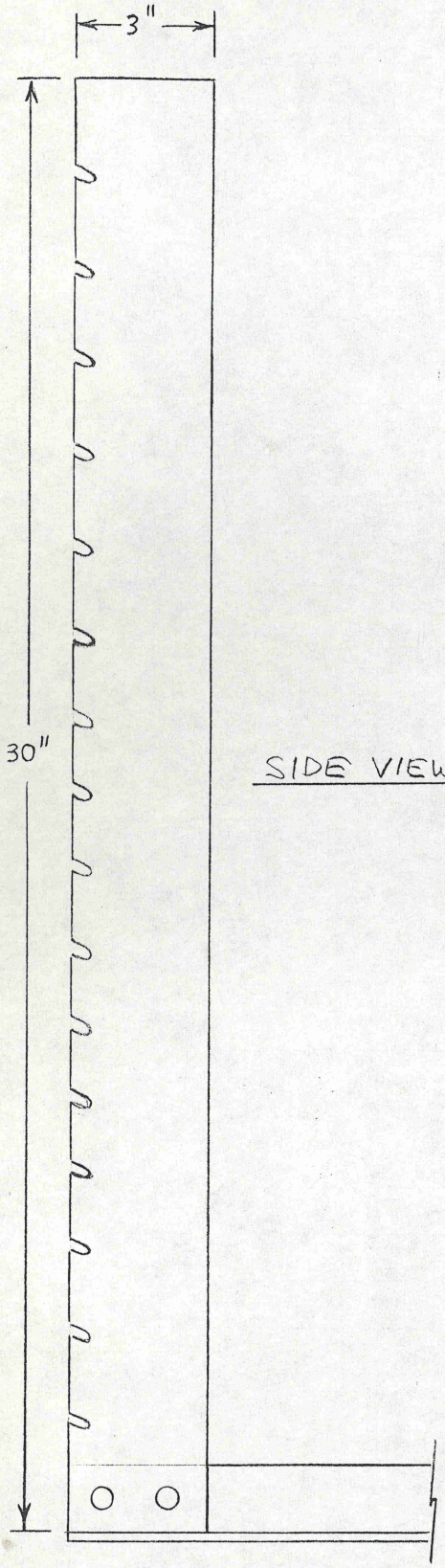
A	942.5
B	848.2
C	552.9
D	483.8
E	301.6
F	251.3
G	125.7
H	75.4
I	37.7
J	12.6

3,632' K = 63' TOTAL = 3,695'

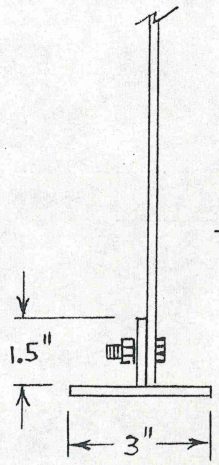
1-12-94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

SECONDARY COIL
OUTER-MOST HELIX BOBIN SUPPORT
(TYP., 32 PLCS.)



SIDE VIEW



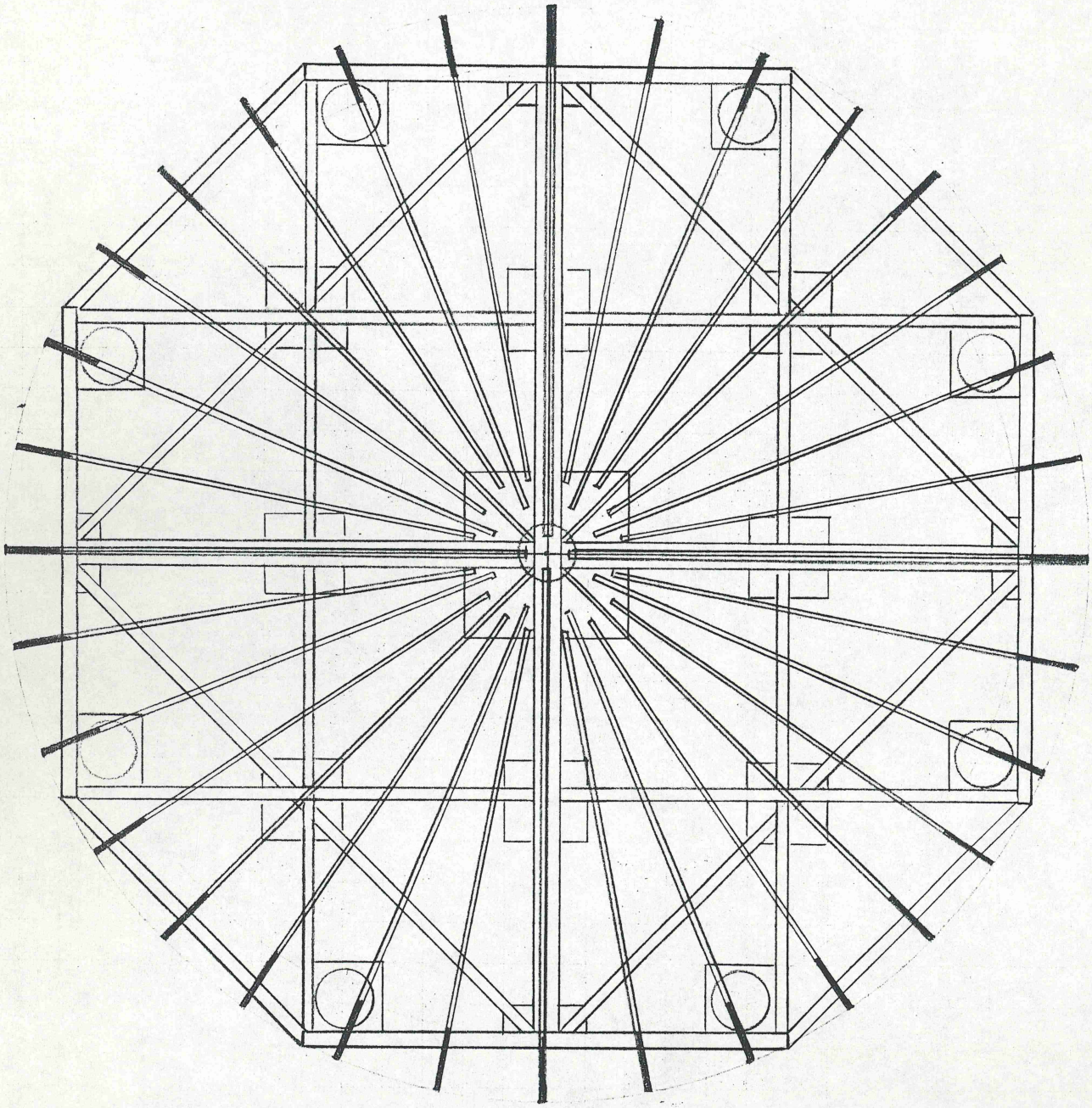
END VIEW DETAIL

1-12-94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER SYSTEM

SECONDARY & PRIMARY COIL PLAN VIEW



0 1.25 2.5 5 10

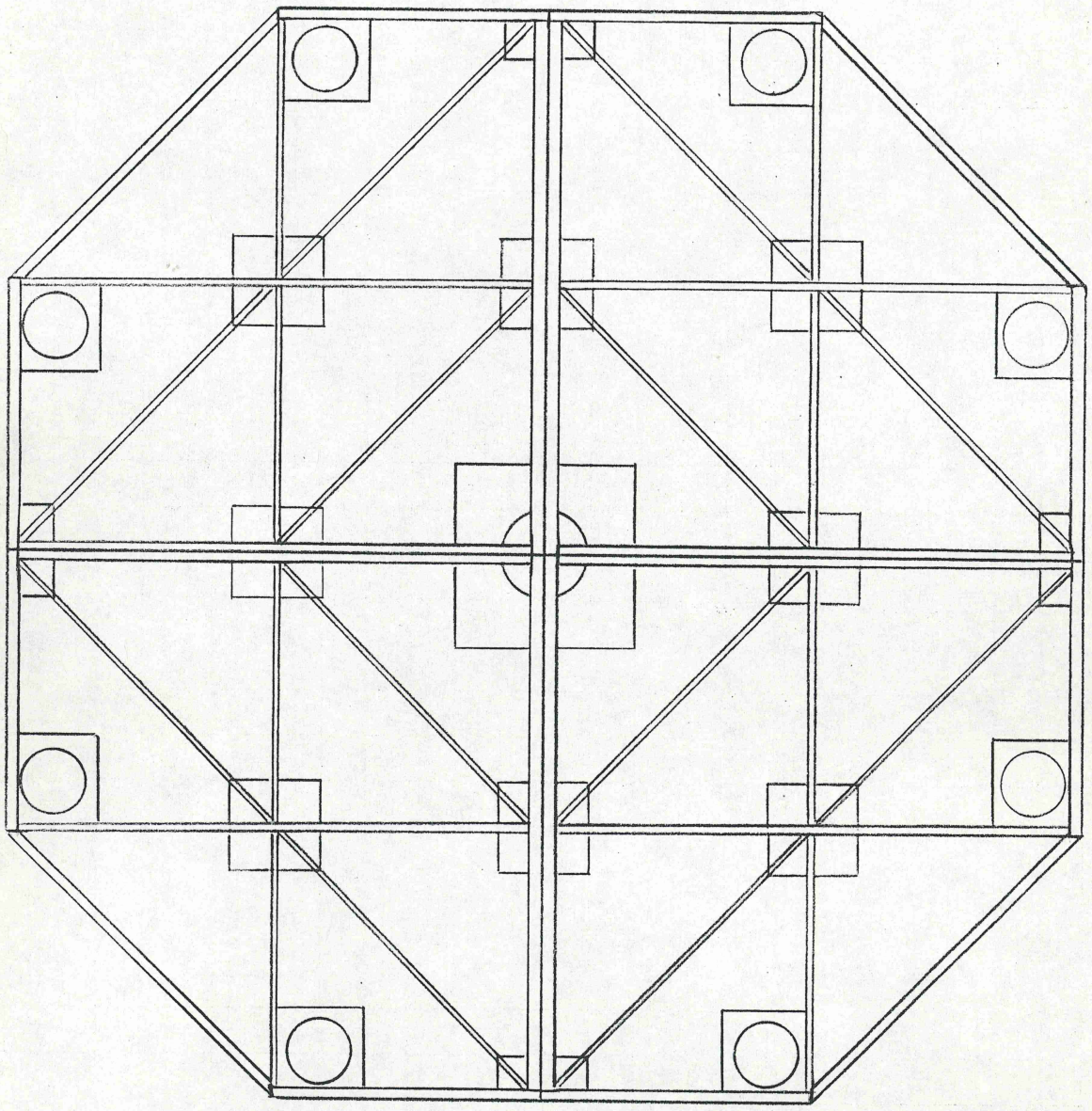
SCALE, FEET

32 PCS. TOTAL
16 PCS. 12' LONG
16 PCS. 10' LONG
352 LINEAR FEET TOTAL

REV-1 1/13/94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER SYSTEM
1ST STAGE SUPPORT FRAME



1/13/94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



SPRINGFIELD, MA 011
FEB 16
1994

SPRINGFIELD, MA 011
FEB 16
PM
1994

SPRINGFIELD, MA
FEB 16
PM
1994

O. W. LANDERGREN, INC.
1500 WEST HOUSATONIC STREET
PITTSFIELD, MASSACHUSETTS 01201-7508

TO:

Tesla Technology Res.
2527 Treelane Ave.
Monrovia, CA 91016

Attn: Bill Wysock

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PHONE: 413-442-5632
413-445-5604
FAX: 413-499-0614

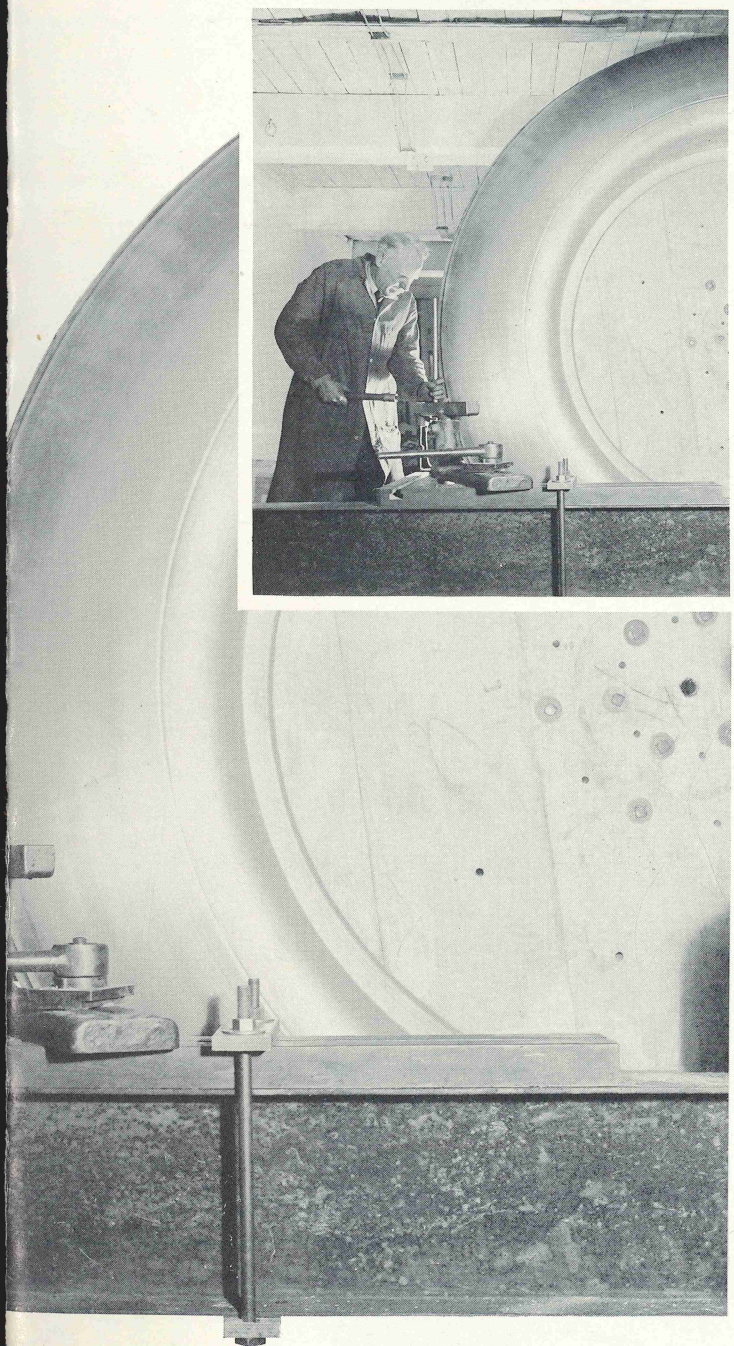
GENERAL MACHINE WORK
DEVELOPMENT WORK
HELI-WELDING
FABRICATION

O. W. LANDERGREN, INC.
METAL SPINNING
& FABRICATIONS

MARK R. PRATT
ASST. TO THE PRESIDENT

1500 W. HOUSATONIC ST.
PITTSFIELD, MASS. 01201

The W. Landergren Story



The O. W. Landergren Metal Spinning Company was founded by Oscar W. Landergren over sixty years ago. Mr. Landergren was an industrious, highly skilled craftsman who took great pride in his work. His extensive experience, spanning forty years, earned him a reputation for unsurpassed quality, production and reliability. His customers included some of the nation's largest manufacturers. Oscar Landergren produced the original "Spun Corona Shields" for General Electric's first High Voltage Laboratory; one of his hand spinnings has been placed in the Bureau of Standards in Washington, D. C. When he retired in 1956, he sold his business to three experienced employees - Paul Polidoro, Edward Bartlett and Arthur Goodrich - who operate the company with the same high standards he established.

Today, O. W. Landergren, Inc. has a work force of 40 people. The company does business throughout North America and includes among its valued customers: The United States Government, General Electric, IBM, Raytheon, Hughes Aircraft and Damon Corporation. To meet increased demands and offer greater capabilities, a new building has been erected with expanded plant facilities, housing 30,000-square-feet of production space. O. W. Landergren offers its customers expert prototype and production metalcrafting through its complete spinning, fabrication and welding, machining and inspection departments.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

ADDITIONS TO FACILITIES LIST

1 46" Dia. swing Machine Lathe
1 Vertical Lagun Miller
1 Pierce-All 50 ton Perf-O-Mator
1 Hurco CNC Milling Machine
1 12" dia. x 18" high High Capacity Vacuum Furnace
1 3 ft. seam welder

Faci

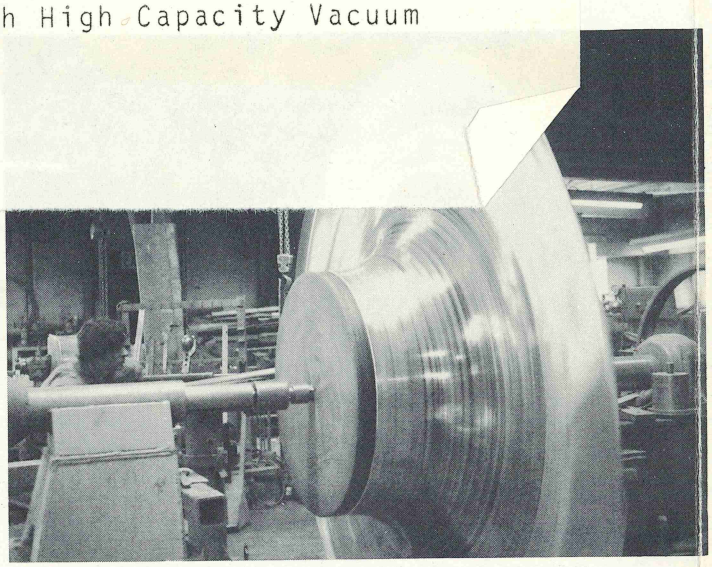
Lan
metal
plete f
plus t
prototy
comm
us to c
tion w

Metal

13 Sp
Capacity from 18" to 132" swing, also, hydraulic assist equipment for heavier gauge material.

Other Machine Shop Equipment

14 Machine Lathes
10" to 36" diameter swing, plus a 19" tracer lathe.
1 Vertical Cincinatti #3 Miller
1 Vertical Bridgeport Miller Series III
5 Vertical Bridgeport Millers #12/BJR
2 Horizontal Millers
1 Brown & Sharpe Surface Grinder
4 Punch Presses - 15 to 70 ton capacity
1 Hydraulic Arbor Press - 10 ton
1 Vertical Hydraulic Press - 70 ton
12 Drill Presses
1 Niagara 3 ft. Shear
1 Niagara 10 ft. Power Shear
5 Niagara & Pexto Ring & Circle Shears
2 Do-All Saws
1 Radial Saw
1 Friction Cut-Off Saw
1 Band Saw
1 Dual Buffer
2 Belt Grinders
2 Power Hack Saws
1 6 ft. Hand Brake
1 8 ft. Hand Brake
1 10 ft. Power Press Brake
4 Sets Rolls
2 Riveters
1 Pierce-All Perf-O-Mator Hole Punching Machine



1 Hydraulic Notching Machine
1 Power Sheet Burring Machine

From this complete line of machinery, we are equipped to make our own tools, dies, jigs and fixtures to produce custom parts and complete model assemblies for our customers. Two critical factors in making our own tooling are speed and quality control.

Heat Treating and Annealing Equipment

1 20" x 20" x 48" Heavy Duty Electric Furnace with Recorder
1 14" x 14" x 20" High Temperature Gas Furnace

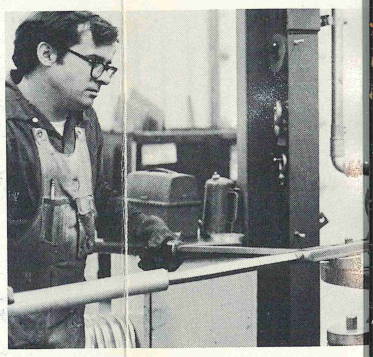
Welding Equipment

6 Tig Heli-Welders 300 KVA
2 Mig Production Welders 300 KVA
4 Welding Positioners
4 Acorn Welding Tables
2 Spotwelders - 15 KVA & 25 KVA

M

Work-in-process insp





Metal Finishing Equipme

1 Set aluminum cleaning
1 Complete set of tanks fo aluminum

Inspection Equipment

1 Inspection room equipp ite surface plates and all measuring tools and g vide first piece, in proc inspection. Our limit of C is determined by custo ments to commercial or ards.

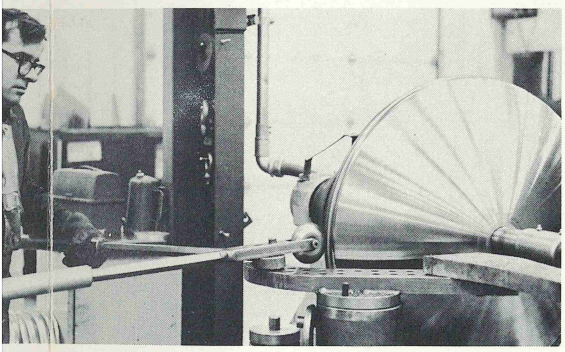
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O.W. LANDERG

Metal Spinning, Metal Fabrication and

Work-in-process inspection.





l Finishing Equipment

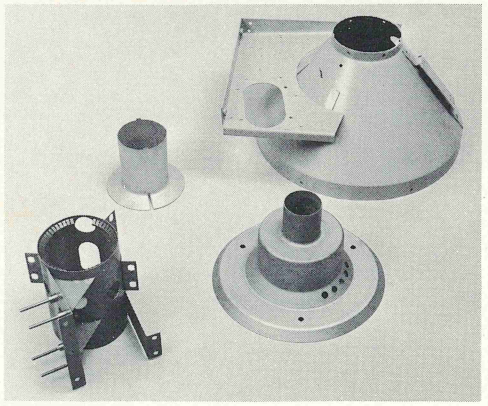
t aluminum cleaning tanks
omplete set of tanks for chromating
uminum

ection Equipment

spection room equipped with gran-
surface plates and all the necessary
easuring tools and gauges to pro-
de first piece, in process and final
spection. Our limit of Quality Control
determined by customers' require-
ents to commercial or military stand-
ds.

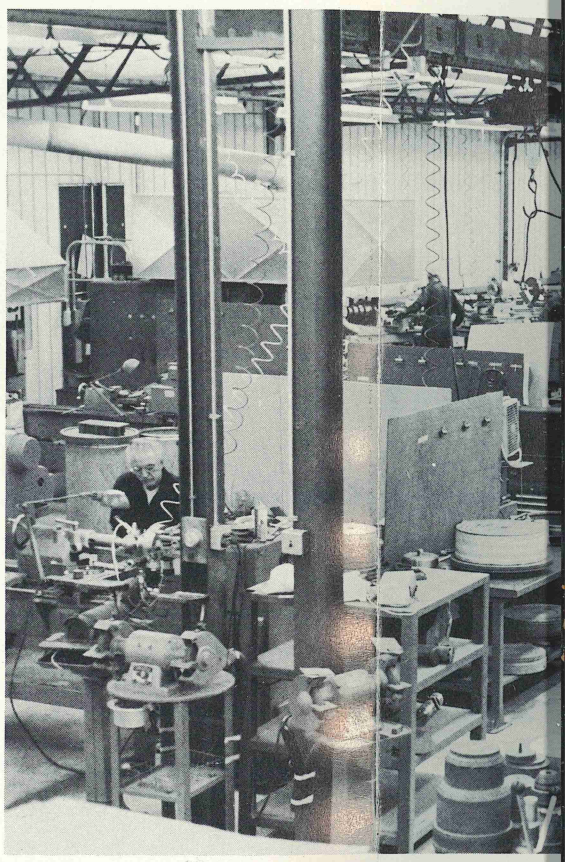
The buffing operation on a one-meter high-voltage sphere gap.

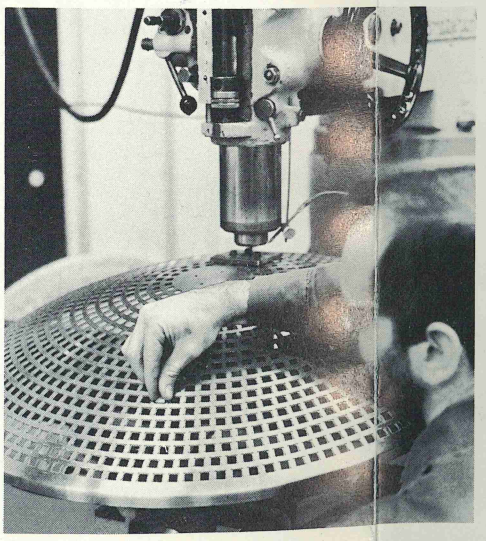




Various shapes of magnetic shields utilizing such metals as hipernom and mu-metal (above). Metal spinning expertise at Landergren's (above left).

Machining and spinning departments at Landergren's facility.





This special wafer-dome for manufacture of computer chips was designed by O. W. Landergren.



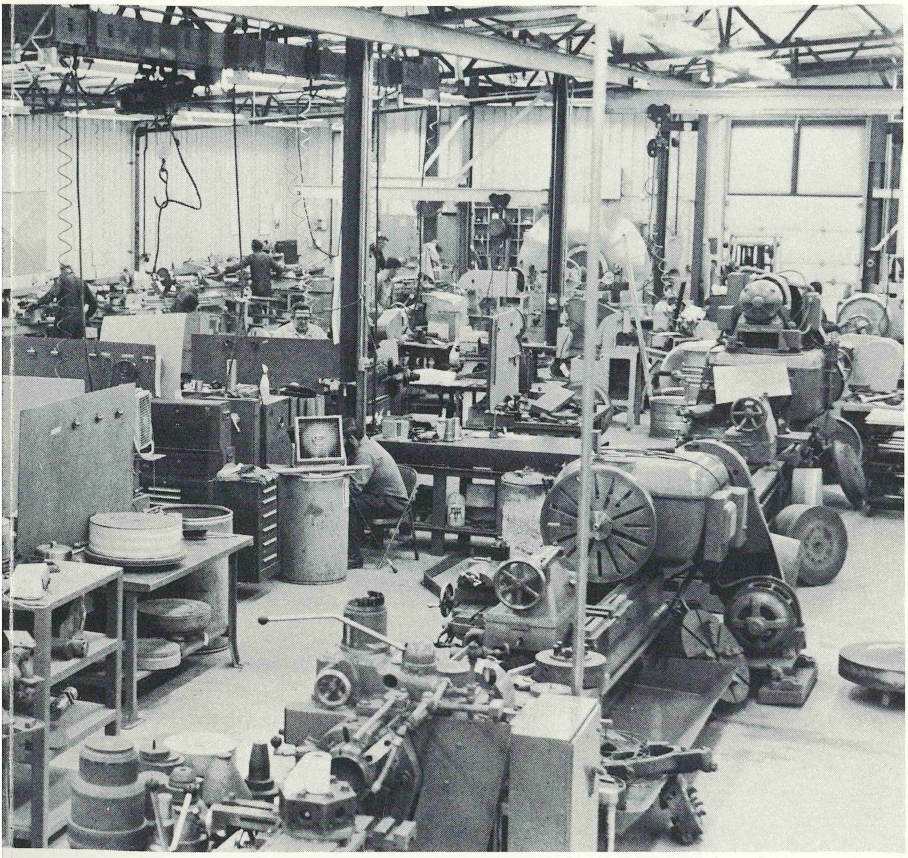
Craftsr

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

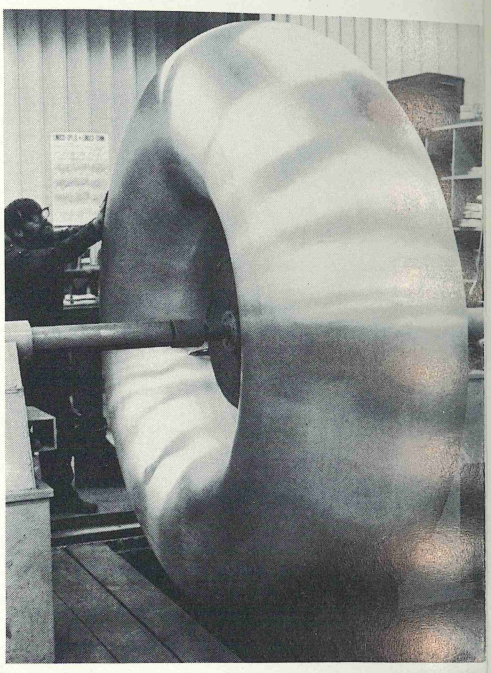
ERGREN, INC.

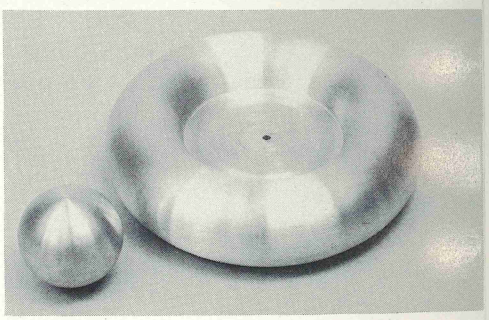
and Complete Metalcraft Facilities

ents at



Putting the finish on a 96-inch diameter high-voltage corona shield.



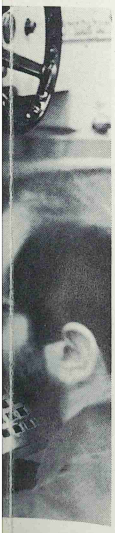


Corona shields range in size from 1" diameter to 100".

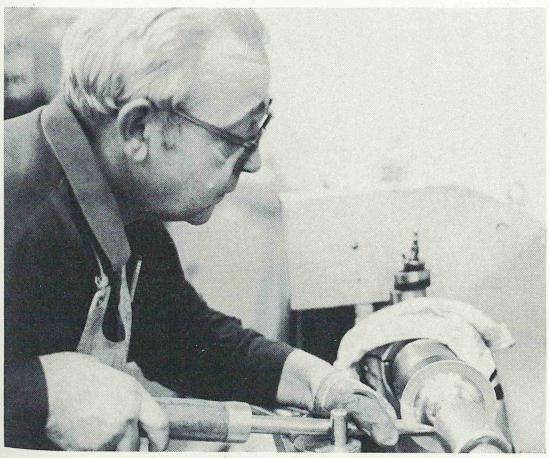
Welding compone jet assembly.



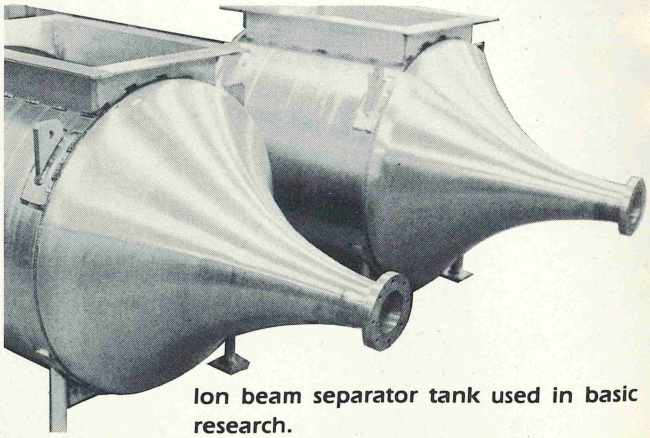




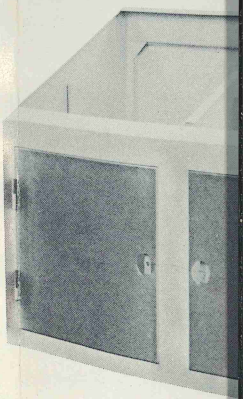
facture
y O. W.



Craftsmanship is still the core of our business.



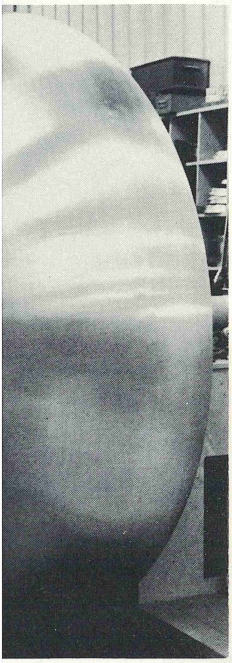
Ion beam separator tank used in basic research.

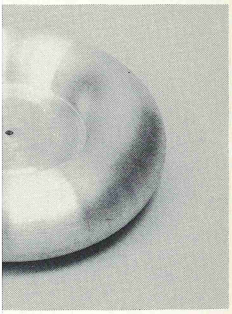


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

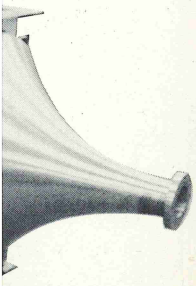
es

96-inch diameter
ield.



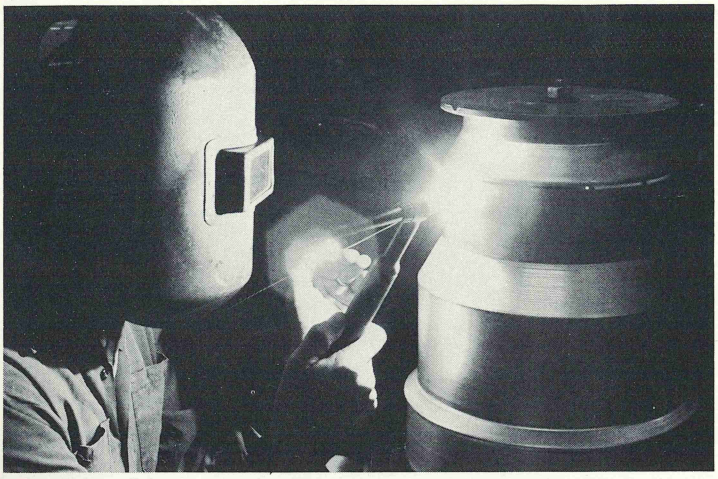


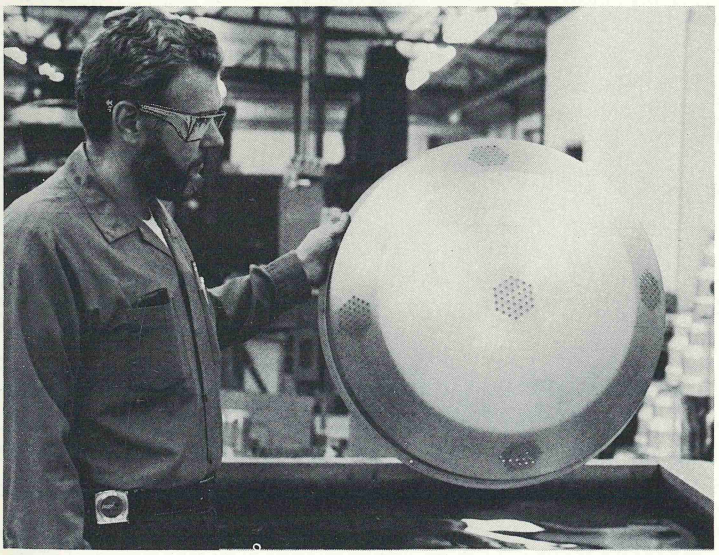
in size from 1"



nk used in basic

Welding components into a high-vacuum jet assembly.





The extent of Landergren's experience is best illustrated by the variety of products manufactured:

* corona shields
* missile components
* metal ceramic seals
* air flow nozzles
* transformer components
* air conditioning components
* magnetic shields
* radar assemblies
* heat shields
* vacuum tanks
* medical equipment
* air conditioning components

Our metal fabricating experience includes:

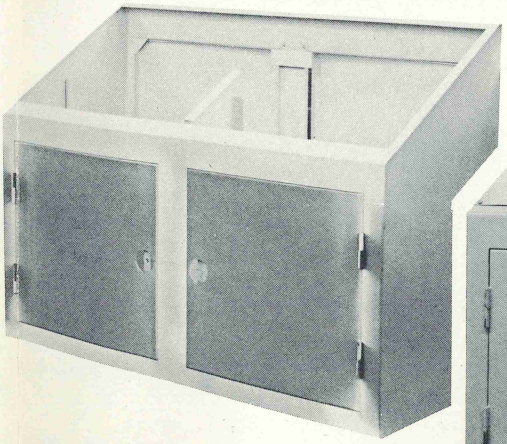
* cabinets
* housings
* brackets
* frames
* panels
* boxes

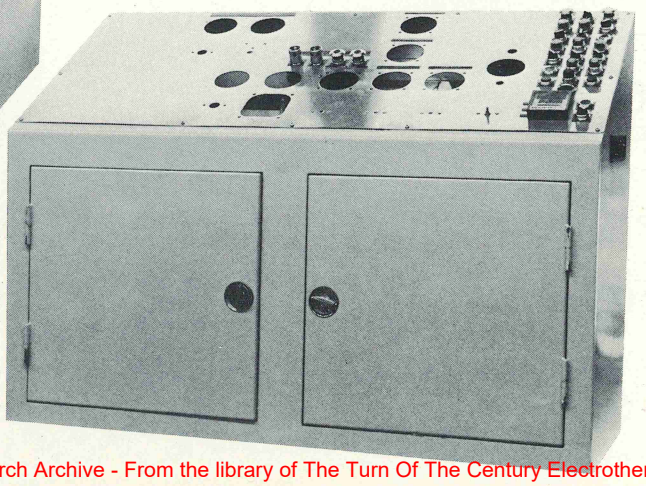
O. W. Landergren works with a wide range of common and exotic metals, including:

* steel
* stainless steel
* nickel
* mu-metal
* tantalum
* aluminum
* bronze
* nickel iron
* monel
* hipernom
* brass
* copper
* kovar
* inconel
* hastaloy
* tungsten
* molybdenum

The cleaning process on a finished component.

Fabricated control station shell (left), with custom-designed control panel attached (below).





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



Manager,
am Quadrozzi,
odridge,
ers (bottom).

O.W. LANDERGREN, INC.



1500 W. HOUSATONIC STREET
PITTSFIELD, MASSACHUSETTS 01201
(413) 442-5632 445-5604

We specialize in:

* Developmental jobs
* Prototypes
* Short runs
* Quantity runs where quality is critical

Our expertise includes:

* Metal spinning
* Metal fabricating and welding
* General machine work

Among the industries we serve:

* Electronic
* High voltage
* Computer
* Medical

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Le Us

Manufactu
Landergren fo
and money,
profession is
learned it fro
technological

Experience

At Landergr
bines with a f
every job. We
age employee
officers have c
ated the equip

Consultation

With this ex
for consultatio
glad to discuss
cutting cost.

Prototype Ma

Our capacity
turing, as well
over many yea
customers wh
fast delivery.

Quality Contr

O. W. Landergren is an experienced, well-equipped organization, maintaining strict production scheduling, with quality control from the beginning of a job to its completion. Two inspectors quarantee the quality of the work we produce.

Certification

Our customers are quaranteed to get what they order. We work to industry standards of tolerance. Our welders are certified to Mil.-T-5021D and Mil. Std.-1595. And we work primarily with certified metals.

Satisfied Customers

The fact that the majority of our orders come from customers previously serviced for many years is your further assurance of satisfaction.

Serving You

Our job is to service all facets of industry, and to serve you with a personal concern.

110"

98" x 14"

96" 36" 30"

4 - 8 WKS

88 64 12

76" 54 1/2 10 3/4

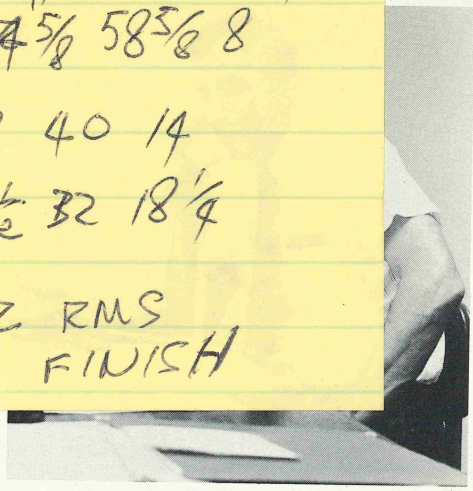
74 5/8 58 5/8 8

68 40 14

68 1/2 32 18 1/4

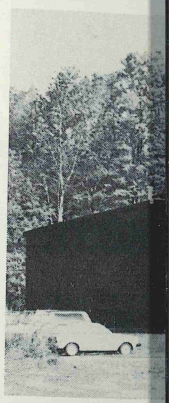
#32 RMS FINISH







Paul Polidoro, President, and Robert "Gus" Murray, Shop Manager, designing special tooling for cost-effectiveness (top). William Quadrozzi, Office Manager, discussing job status (center). George Goodridge, Sales Manager, maintaining close contact with all customers (bottom).



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Le
Us

Manufactures know they can depend on O. W. Landergren for quality production, saving time and money, and offering reliable delivery. Our profession is a highly specialized craft - we have learned it from its origins and kept abreast of all technological advances.

Experience

At Landergren's, the skill of individuals combines with a full range of equipment to produce every job. We train all our own people. Our average employee has 15 years of experience. All our officers have come up "from the ranks" and operated the equipment that serves our clients.

Consultation Services

With this experience, we are readily available for consultation, and whenever possible we are glad to discuss methods for improving quality and cutting cost.

Prototype Manufacturing

Our capacity for complete prototype manufacturing, as well as production work, has developed over many years of working with and satisfying customers who demand high quality and require fast delivery.

Quality Control

O. W. Landergren is an experienced, well-equipped organization, maintaining strict production scheduling, with quality control from the beginning of a job to its completion. Two inspectors quarantee the quality of the work we produce.

Certification

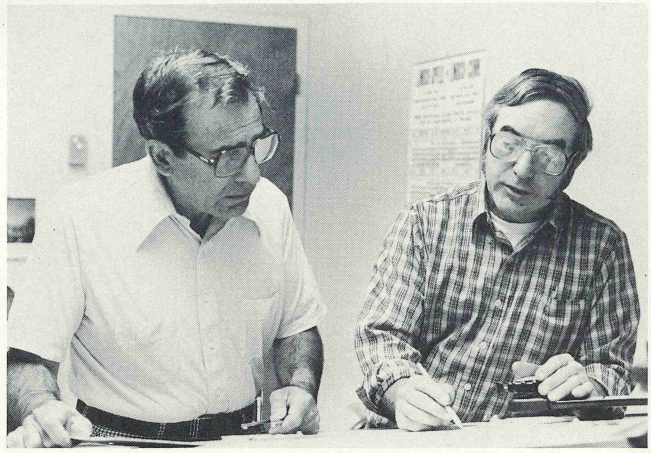
Our customers are quaranteed to get what they order. We work to industry standards of tolerance. Our welders are certified to Mil.-T-5021D and Mil. Std.-1595. And we work primarily with certified metals.

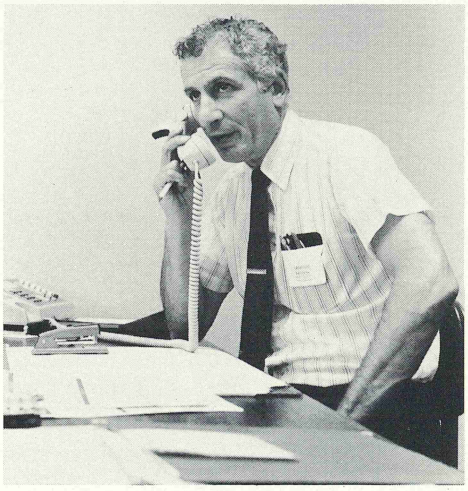
Satisfied Customers

The fact that the majority of our orders come from customers previously serviced for many years is your further assurance of satisfaction.

Serving You

Our job is to service all facets of industry, and to serve you with a personal concern.





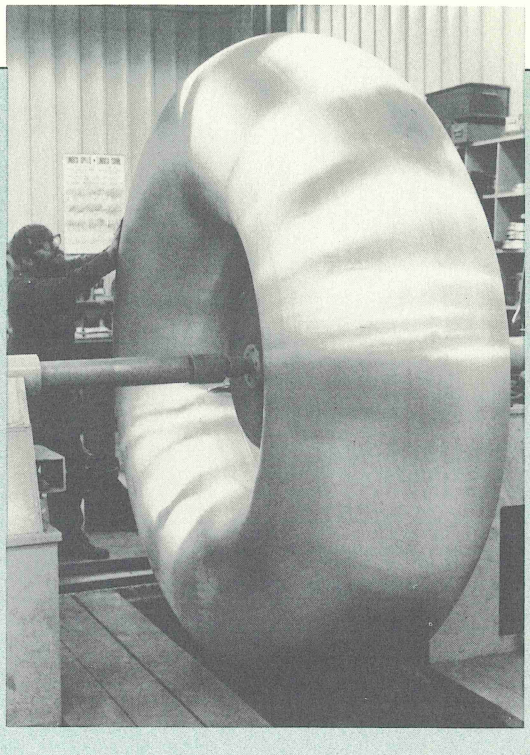


Paul Polidoro, President, and Robert "Gus" Murray, Shop Manager, designing special tooling for cost-effectiveness (top). William Quadrozzi, Office Manager, discussing job status (center). George Goodridge, Sales Manager, maintaining close contact with all customers (bottom).

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

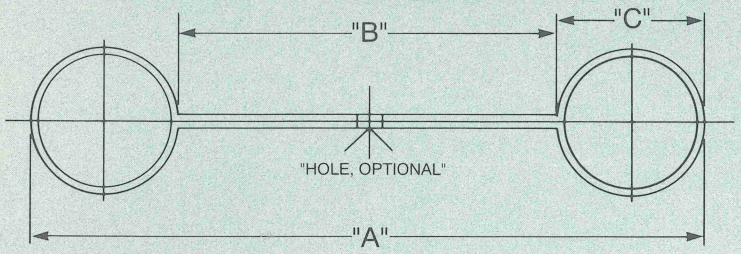
EXISTING TOOLING

TOROIDS & CORONA SHIELDS



Corona Ring Tooling On Hand

MATERIAL: Aluminum 1100-0 or 3003-0



" A" DIM	"B" DIM	"C" DIM
3"	2.500"	.250"
4"	3"	.500"
4"	2"	1"
6"	5"	.500"
7"	3.500"	1.750"
7.375"	6.375"	.500"
7.375"	6.120"	.630"
8"	4"	2"
8"	6"	1"
8.250"	7.250"	.500"
9.250"	7.250"	1"
10"	5"	2.500"
10"	8.500"	.750"
10"	6"	2"
10"	8.500"	.750"
12"	7"	2"
12"	8"	2"
12"	8.500"	1.750"
12"	10"	1"
12.500"	9.500"	1.500"
14"	12"	1"
14"	10"	2"
14"	6"	4"
14"	7"	3.500"
15"	11""	2"
16"	12"	2"
16"	6"	5"
16.500"	12.500"	2"
18"	9"	4.500"

" A" DIM	"B" DIM	"C" DIM
18"	12"	3"
18.125"	14.125"	2"
19"	10"	4.500"
19"	16"	1.500"
20"	6"	7"
20"	10"	5"
20"	14"	3"
20.250"	16"	.125"
20.250"	12.250"	4"
20.500"	18.500"	1"
22"	18"	2"
24"	12"	6"
24"	19"	2.500"
24"	14"	5"
25"	21"	4"
25.500"	21.500"	2"
28"	14"	7"
30"	12"	9"
30"	16"	7"
30.500"	24.500"	3"
34"	17"	8.500"
36"	30"	3"
36"	24"	6"
36"	16"	10"
38"	18"	10"
40"	28"	6"
40"	20"	10"
41"	29"	6"

" A" DIM	"B" DIM	"C" DIM
42"	22"	10"
43.250"	19.750"	11.750"
46.250"	36.250"	5"
47"	39"	4"
48"	42"	3"
48"	40"	4"
48"	36"	6"
48"	24"	12"
48"	33"	7.500"
50"	18"	16"
52"	44"	4"
52"	40"	6"
56"	28"	14"
57"	47"	5"
58"	34"	12"
59"	49"	5"
59"	31.500"	13.750"
61"	39.500"	10.750"
68"	40"	14"
68.500"	32"	18.250" ←
74.625"	58.625"	8"
76"	54.500"	10.750" ←
88"	64"	12" ← 2,360
96"	36"	30"
98"	70"	14"

Metal Spinning • Metal Fabricating & Welding • General Machining

1500 W. Housatonic Street Pittsfield, Massachusetts 01201 (413) 442-5632 445-5604 • Fax (413) 499-0614

O.W. LANDERGREN, INC.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O. W. Landergren, Inc.

METAL SPINNING

1500 W. HOUSATONIC ST. • PITTSFIELD, MASS. 01201 • PHONE 442-5632 & 445-5604
FAX 499-0614

QUOTATION

Tesla Tech Res.
2527 Treelane Ave.
Monrovia, CA 91016

DATE 2/15/94

GENERAL MACHINE WORK
FABRICATION
HELI-WELDING
DEVELOPMENT WORK

Attn: Bill Wysock

REFERENCE

Recent request for quotation

QUANTITY	DESCRIPTION	PRICE	DELIVERY DATE
1 pc.	Aluminum Toroid 96" x 36" x 30"	$3,700.00 ea	Approx. 6-10 wks
2 pcs.	Aluminum Toroid 76" x 54 1/2" x 10 3/4"	1,750.00 ea	ARO
	NOTE: Prices include wood shipping box.		
TOOLING			

SHIP 6-7

850 LBS. GROSS

$520.00

50% DOWN

50% ARO

TERMS: NET 30 DAYS

TOTAL

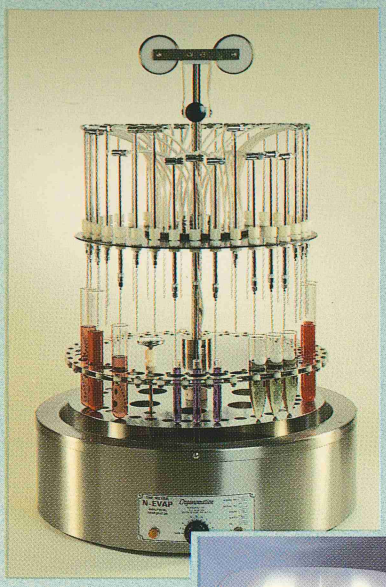
F.O.B. Pittsfield, MA

O. W. LANDERGREN, INC.

SIGNED BY Mark R Pratt

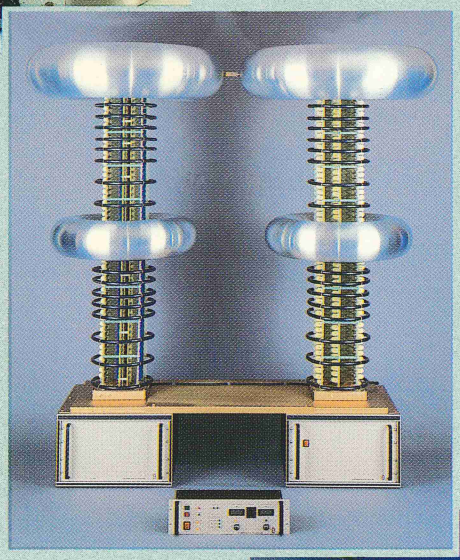
Mark R. Pratt

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

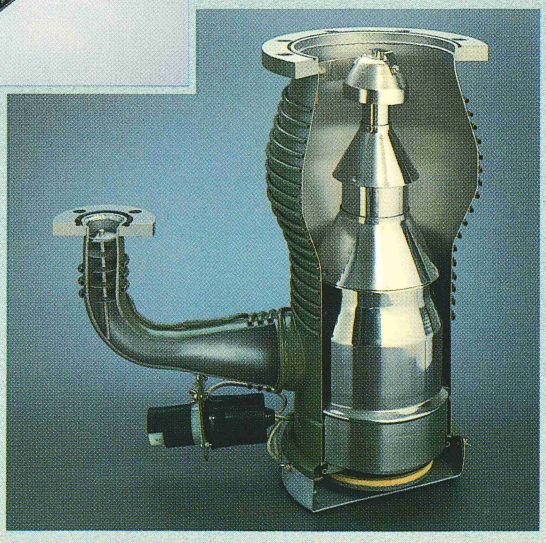


UNSURPASSED QUALITY.

O.W. LANDERGREN, INC.







Metal Spinning
Metal Fabrication
And Complete Metalcraft Facilities

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O.W. LANDERGREN, INC.

1500 W. Housatonic Street Pittsfield, Massachusetts 01201 Phone (413) 442-5632 • 445-5604 • Fax (413) 499-0614

Specializing in:

• Developmental jobs • Prototypes • Short runs • Quantity runs where quality is critical

Total Quality Assurance Throughout Production in:

• Metal spinning • Metal fabricating and welding • General machine work

Metals Typically Used:

• Steel • Stainless Steel • Nickel • Mu-Metal • Tantalum • Aluminum • Bronze • Nickel Iron • Monel
• Hipernom • Brass • Copper • Kovar • Inconel • Hastaloy • Tungsten • Molybdenum

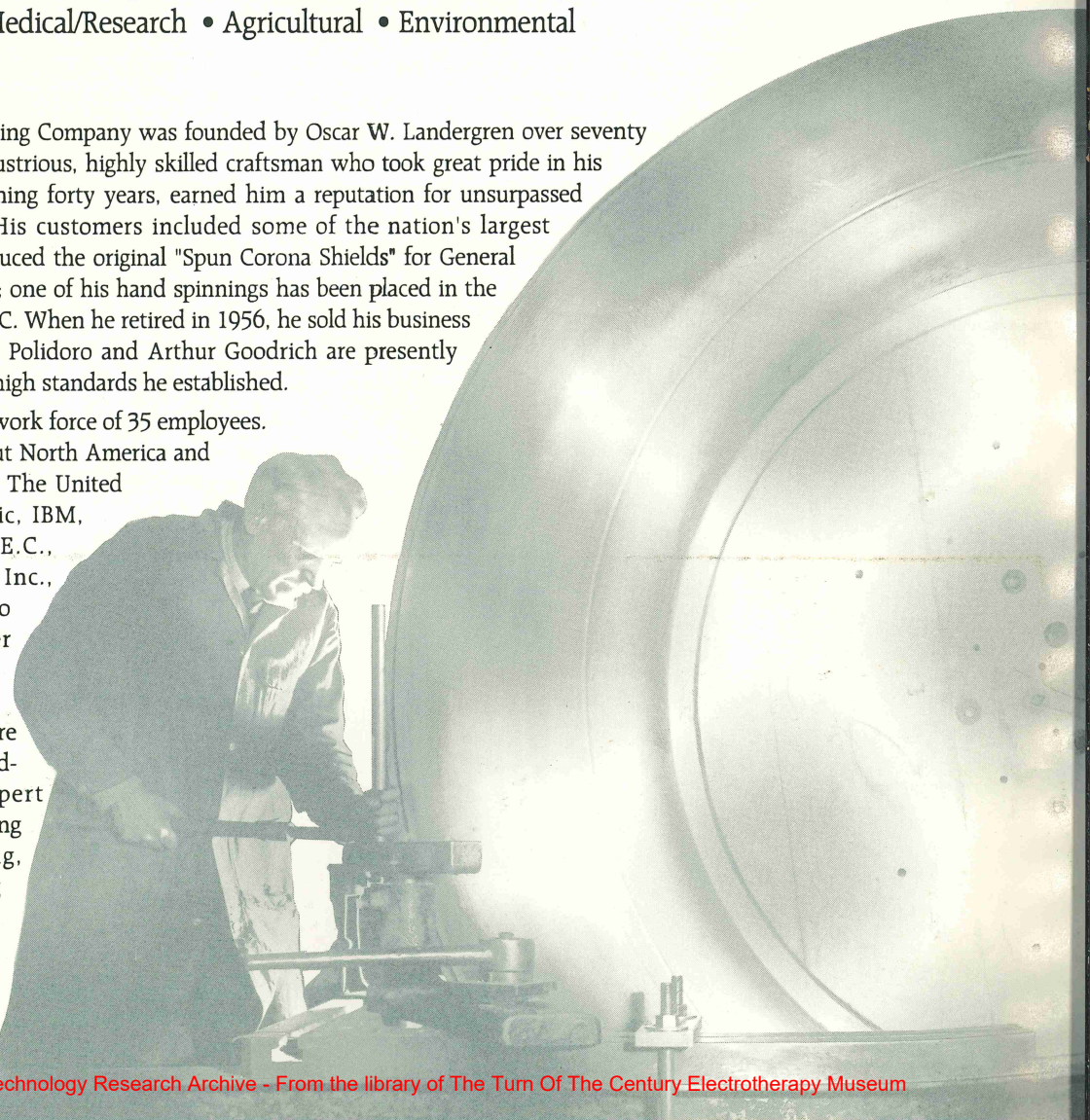
Industries Served:

• Electrical & Power • Government • Computer • Religious Goods • Vacuum • Aerospace • Mechanical
• Architectural/Ornamental • Medical/Research • Agricultural • Environmental

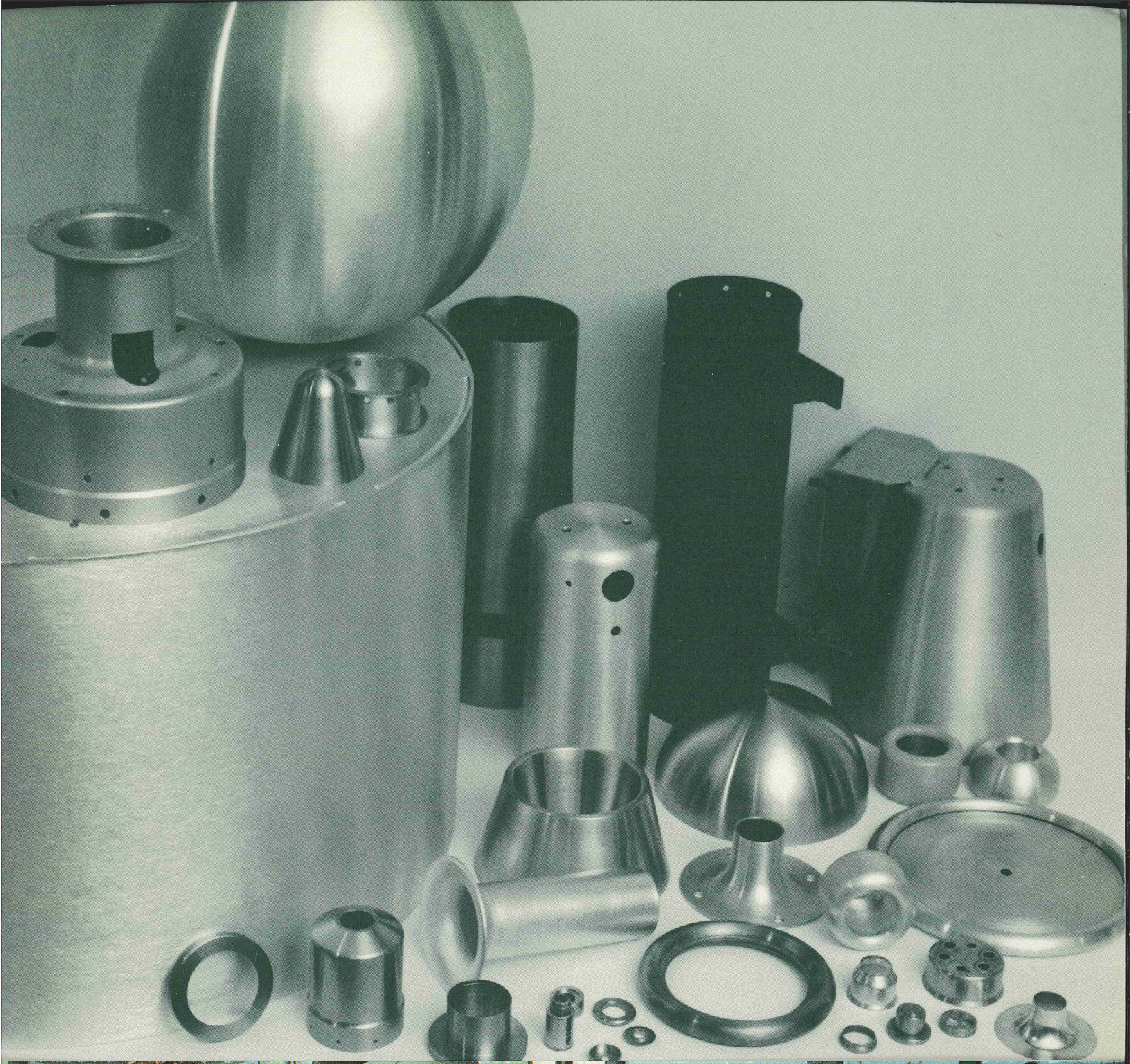
Our story:

The O. W. Landergren Metal Spinning Company was founded by Oscar W. Landergren over seventy years ago. Mr. Landergren was an industrious, highly skilled craftsman who took great pride in his work. His extensive experience, spanning forty years, earned him a reputation for unsurpassed quality, production and reliability. His customers included some of the nation's largest manufacturers. Oscar Landergren produced the original "Spun Corona Shields" for General Electric's first High Voltage Laboratory; one of his hand spinnings has been placed in the Bureau of Standards in Washington, D.C. When he retired in 1956, he sold his business to three experienced employees. Paul Polidoro and Arthur Goodrich are presently operating the company with the same high standards he established.

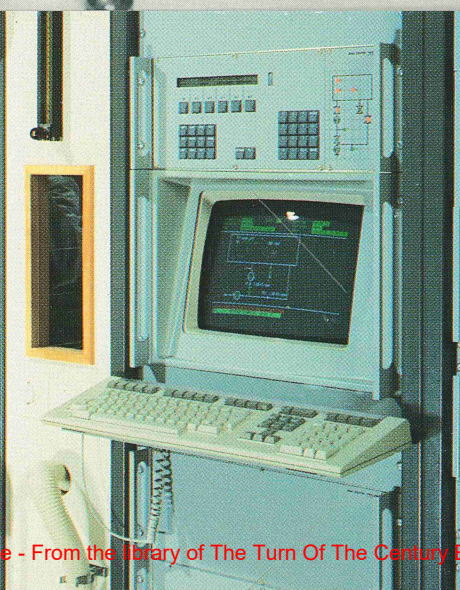
Today, O. W. Landergren, Inc. has a work force of 35 employees. The company does business throughout North America and includes among its valued customers: The United States Government, General Electric, IBM, Raytheon, Lockheed Sanders, I.E.C., Organomation, Balzers, Labsphere Inc., Varian Vacuum, and Hipotronics. To meet increased demands and offer greater capabilities, a new building has been erected with expanded plant facilities, housing 30,000 square feet of production space. O. W. Landergren offers its customers expert prototype and production metalcrafting through its complete spinning, fabrication and welding, machining and inspection departments.

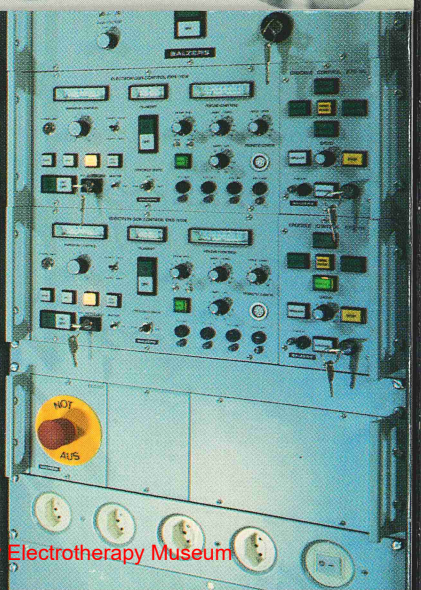


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



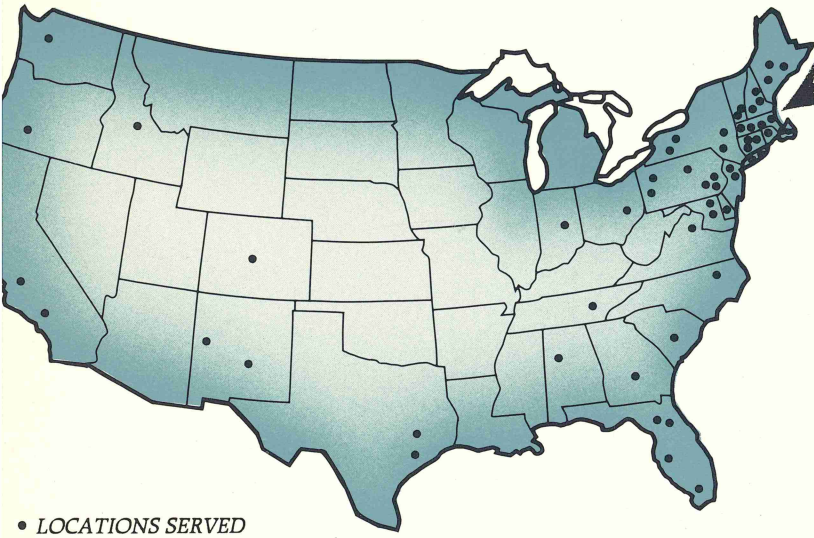






William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





• *LOCATIONS SERVED*

Conveniently located in western Massachusetts, O.W. Landergren, Inc. is easily accessible to all major Northeastern cities.

Our job is to service all facets of industry, and to serve you with a personal concern.

Our customers are guaranteed to get what they order. We work to industry standards of tolerance. Our welders are certified to MIL-STD-2219 and MIL-STD-1595. And we work primarily with certified metals.

O.W. LANDERGREN, INC.

Metal Spinning • Metal Fabricating & Welding • General Machining

1500 W. Housatonic Street Pittsfield, Massachusetts 01201 Phone (413) 442-5632 • 445-5604 • Fax (413) 499-0614

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O. W. LANDERGREN, INC.

1500 West Housatonic Street Pittsfield, MA 01201

Telephone No. Area Code 413 442-5632 & 445-5604

CORONA RING TOOLING ON HAND

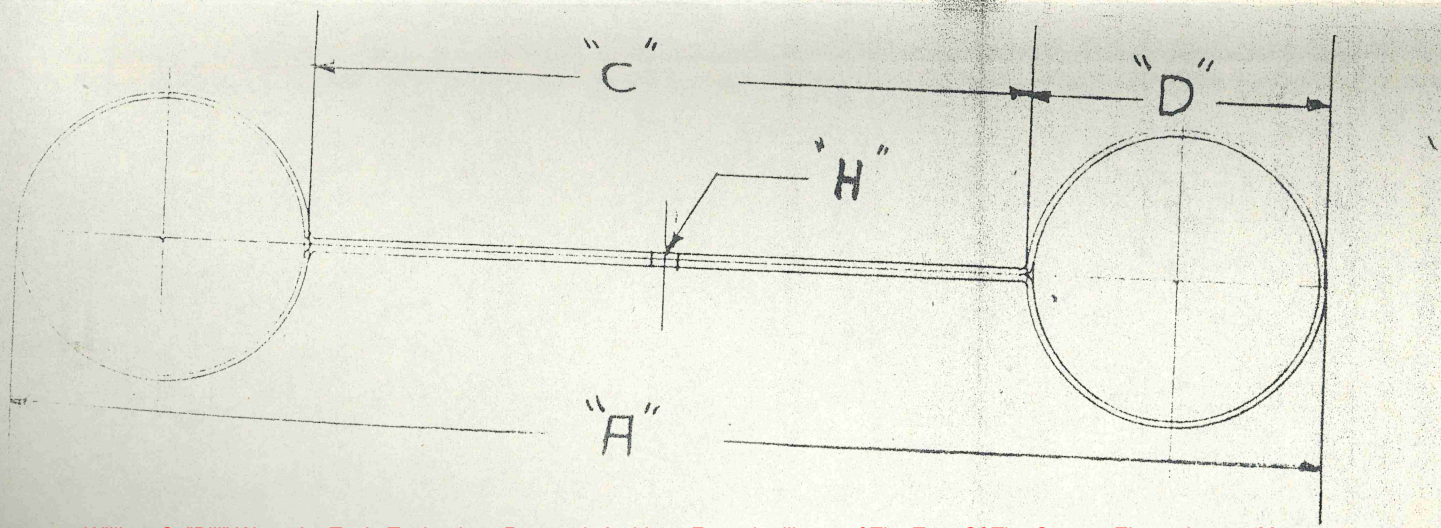
"A" DIM	"C" DIM	"D" DIM
3"	2.500"	.250"
4"	3"	.500"
4"	2"	1"
7"	3.500"	1.750"
8"	4"	2"
9.250"	7.250"	1"
10"	5"	2.500"
10"	6"	2"
12"	8"	2"
12"	10	1"
14"	12"	1"
14"	7"	3.500"
15.750"	12.750"	1.500"
16"	12"	2"
18"	9"	4.500"
18"	12"	3"
20"	6"	7"
20"	14"	3"
24"	12"	6"
24"	19"	2.500"
24"	14"	5"
25.500"	21.500"	2"
30"	16"	7"
30.500	24.500"	3"
28"	14"	7"
30"	12"	9"
34"	17"	8.500"
36"	16"	10"
36"	30"	3"
38"	18"	10"
40"	28"	6"
40"	20"	10"
41"	29"	6"
42"	33"	4.500"
43.250"	19.750"	11.750"
46.250"	36.250"	5"
48"	42"	3"
48"	40"	4"
48"	24"	12"
48"	33"	7.500"
52"	24"	14"
58"	34"	12"
59"	49"	5"
59"	31.500"	13.750"
50"	18"	16"
61"	39.500"	10.750"
68"	40"	14"
68.500"	32"	18.250"
76"	54.500"	10.750"
88"	64"	12"
96"	36"	30"
98"	70"	14"

MATERIAL: Aluminum 1100-0 or 3003-0

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

10"	5"	2.500"
10"	6"	2"
12"	8"	2"
12"	10	1"
14"	12"	1"
14"	7"	3.500"
15.750"	12.750"	1.500"
16"	12"	2"
18"	9"	4.500"
18"	12"	3"
20"	6"	7"
20"	14"	3"
24"	12"	6"
24"	19"	2.500"
24"	14"	5"
25.500"	21.500"	2"
30"	16"	7"
30.500	24.500"	3"
28"	14"	7"
30"	12"	9"
34"	17"	8.500"
36"	16"	10"
36"	30"	3"
38"	18"	10"
40"	28"	6"
40"	20"	10"
41"	29"	6"
42"	33"	4.500"
43.250"	19.750"	11.750"
46.250"	36.250"	5"
48"	42"	3"
48"	40"	4"
48"	24"	12"
48"	33"	7.500"
52"	24"	14"
58"	34"	12"
59"	49"	5"
59"	31.500"	13.750"
50"	18"	16"
61"	39.500"	10.750"
68"	40"	14"
68.500"	32"	18.250"
76"	54.500"	10.750"
88"	64"	12"
96"	36"	30"
98"	70"	14"

MATERIAL: Aluminum 1100-0 or 3003-0



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

General Machine Work | Fabrication | Heli - Welding | Development Work

O. W. Landergren, Inc. METAL SPINNING

1500 WEST HOUSATONIC STREET TELEPHONE (413) 442-5632 or 445-5604 PITTSFIELD, MASS. 01201

STANDARD TOOLS FOR SPHERES

1"	8" dia.
1.775" dia.	8.850"
2"	9"
2.175"	9.725"
2.700"	10"
2.760"	11.750"
3"	12"
3.350"	12.900"
3.750"	14.500"
4"	16"
4.125"	18.375"
4.500"	19.700"
4.625"	20"
4.780"	24"
4.810"	29.250"
4.900"	31"
4.925"	36"
5"	39.125"
5.410"	58.375"
5.880"	60"
6"	65.625"
6.370"	
6.405"	
6.785"	
6.860"	
7"	
7.900"	

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

O. W. Landergren, Inc.

METAL SPINNING

1500 W. HOUSATONIC ST. • PITTSFIELD, MASS. 01201 • PHONE 442-5632 & 445-5604
FAX 499-0614

QUOTATION

Lazer Precision Analytical
17819 Gillett Avenue
Irvine, CA 92714

Attn: Pete Miller

DATE 4/17/90

GENERAL MACHINE WORK
FABRICATION
HELI-WELDING
DEVELOPMENT WORK

REFERENCE: Recent request for quotation

QUANTITY	DESCRIPTION	PRICE	DELIVERY DATE
2 pcs.	20" Diameter hemisphere 1/2-3/4" flange finish to be as spun	$ 96.00 ea.	Approx. 3-4 weeks ARO.
TOOLING			

TOTAL

TERMS: NET 30 DAYS

F.O.B. Pittsfield

O. W. LANDERGREN, INC.

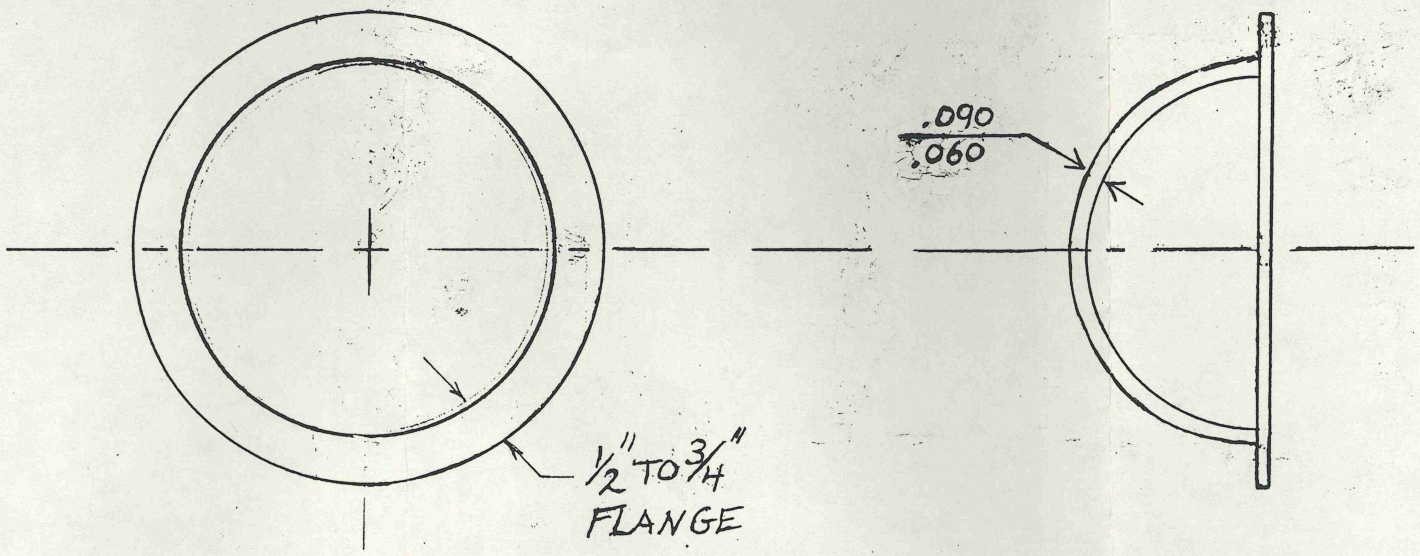
SIGNED BY Mark R. Pratt

Mark R. Pratt

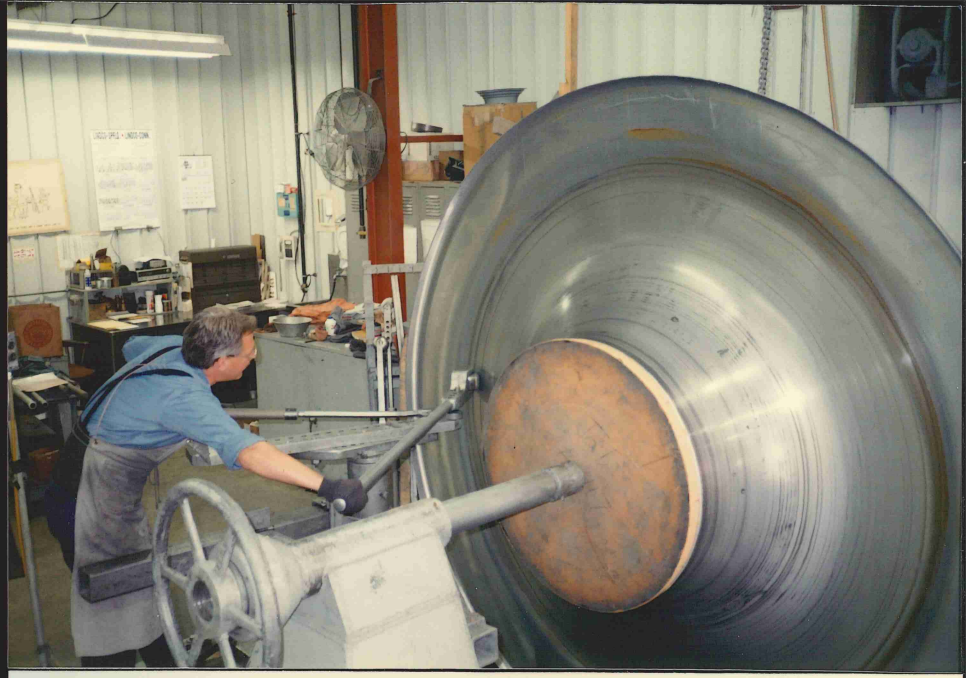
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Man Of The Century Electrotherapy Museum

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

20" Hemisphere



O. W. LANDERGREN, Inc.

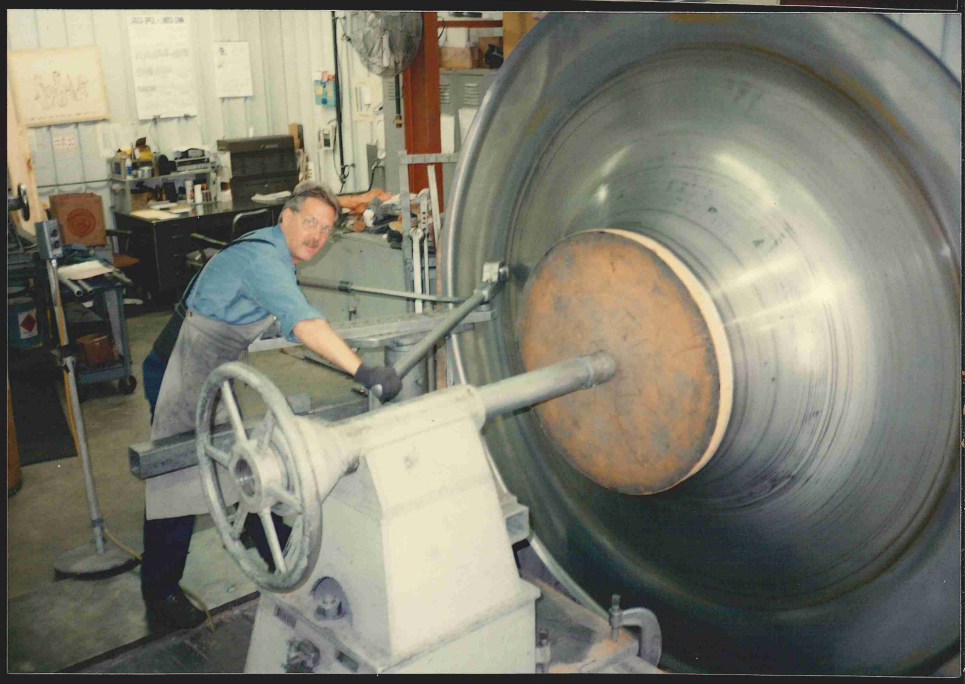






William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



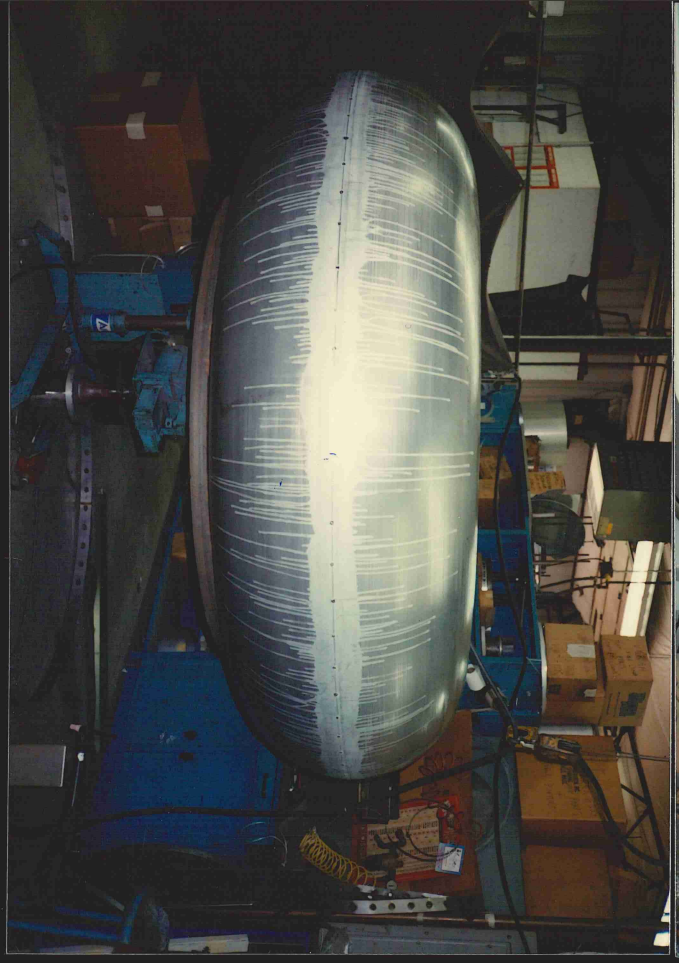


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



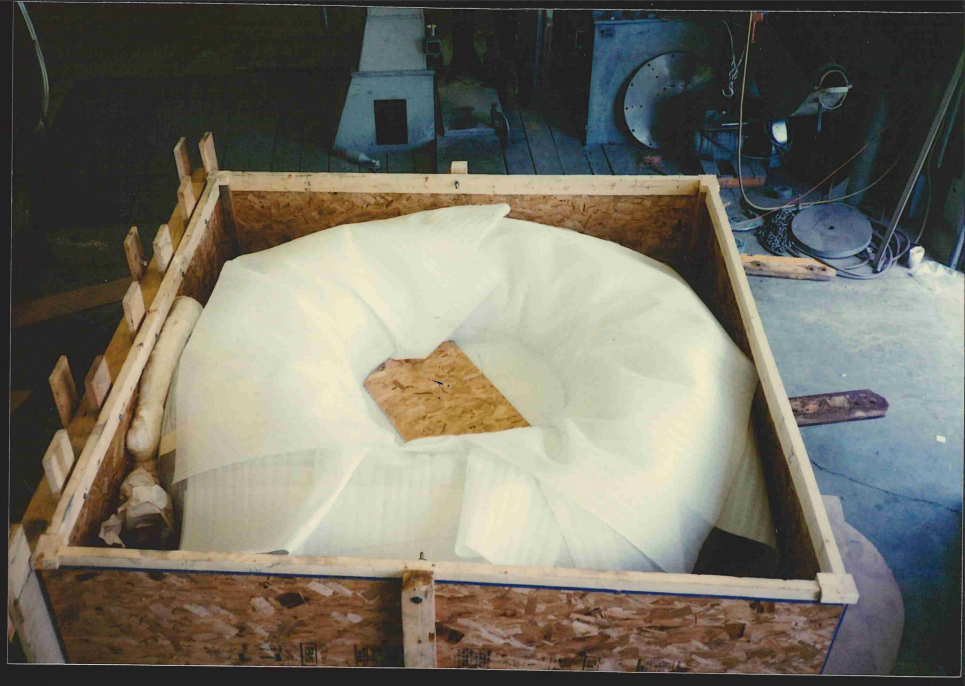


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



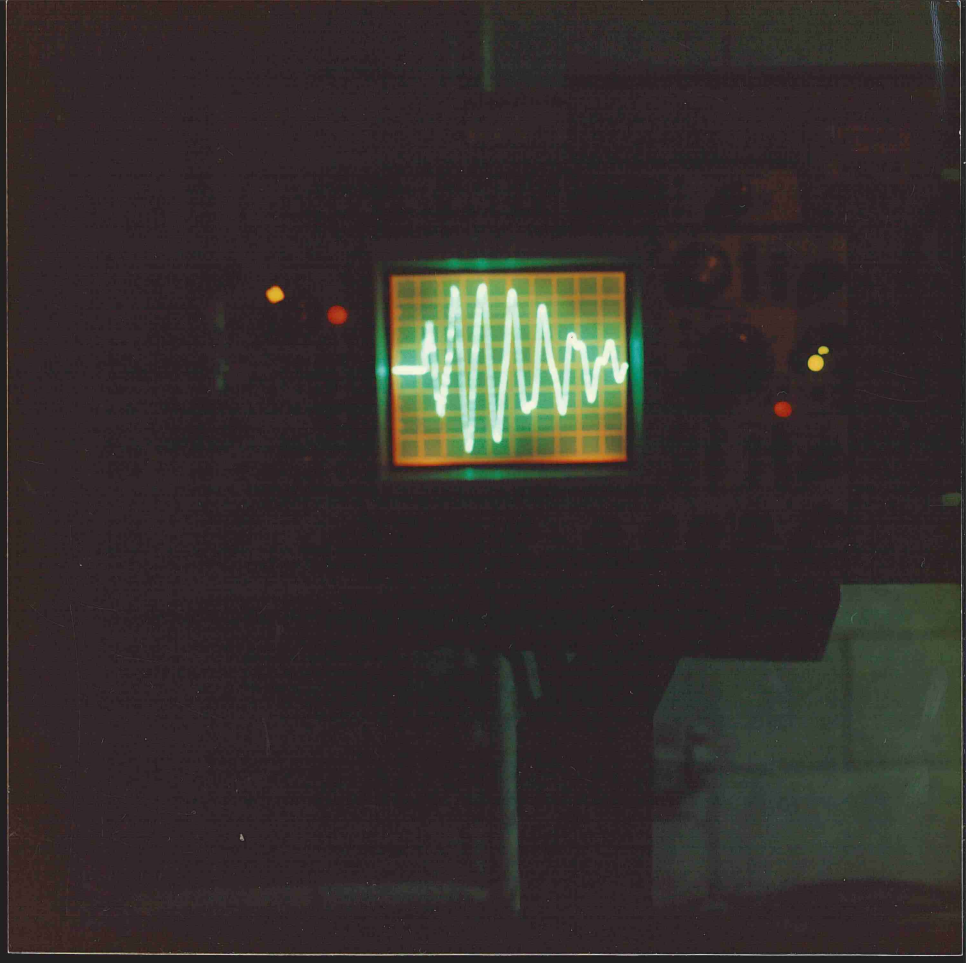
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



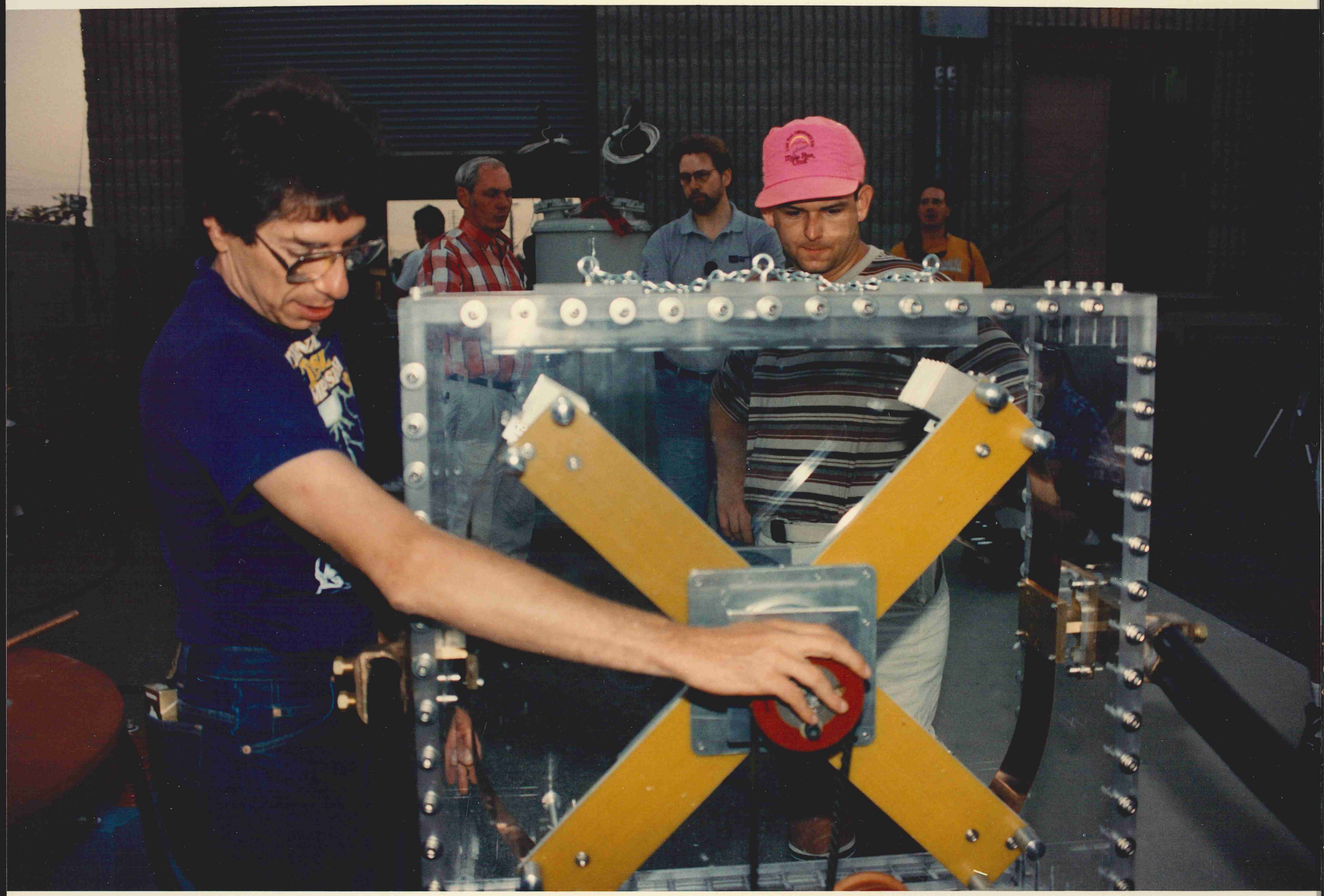
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

BILL,
THE TIME BASE IS 10 μsec/CM
MAXIMUM POWER IS AT 48 KHZ
SAT NIGHT 8-5-95 DAVE QUALLS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Announcing

The New Intermediate Type Hogan High Frequency Apparatus

No. 8075

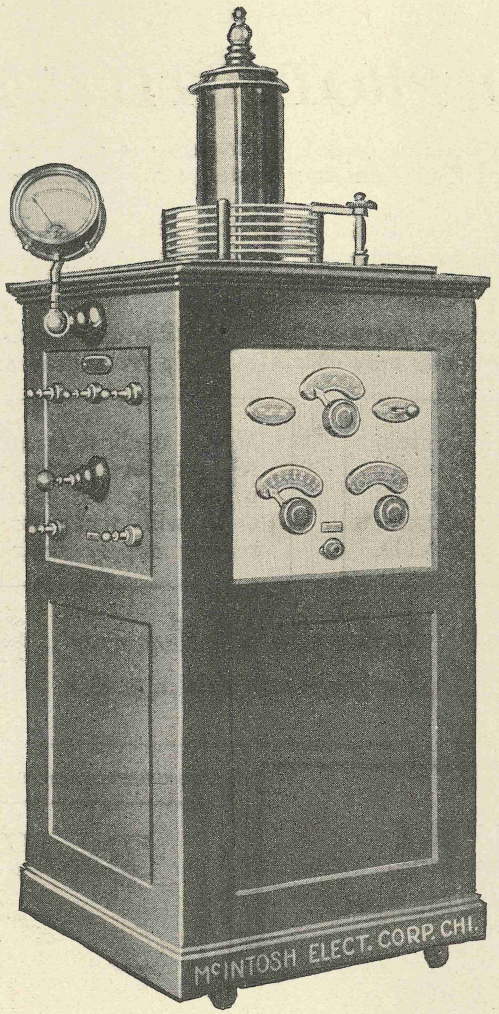
A NEW SPARK GAP which may be run for hours and at the same time assure a smooth and adequate delivery of current.

LOW LOSS, STEP-UP TRANSFORMER of high efficiency.

PERMANENT OIL IMMERSED NON-SPRAYING FRANKLIN PLATE CONDENSER

IMPROVED AUTO-INDUCTANCE CONTROL free from Rheostat troubles.

ELECTRO-COAGULATION for destruction of malignant growths.



No. 8075

D'ARSONVAL CURRENT, with powerful LOW VOLTAGE and High Amperage, assuring the maximum in heating capacity for Diathermy.

OUDIN CURRENT of high voltage for removal of warts, moles and also growths on the most delicate mucous membrane.

TESLA CURRENT of medium voltage and amperage for Auto-Condensation, etc.

THE CABINET is of genuine solid mahogany, and is finished in an exclusive brown tone, constituting an artistic unit of a well appointed office. A hinged door is fitted to the back of the cabinet, thus facilitating inspection of interior, etc. A circular glass pane is embodied in the door, permitting the operator to view the spark gap without the necessity of opening the door of cabinet.

In presenting the No. 8075 Intermediate Type Hogan High Frequency Apparatus we have endeavored to meet the demand of the physician for equipment which will afford him honest service, and clinical results, at a price consistent with the McIntosh policy of supplying only the best.

We have outlined a special introductory proposition which will place this apparatus in your office at a very little expense to yourself. A full equipment is sent with this unit, including folding auto-condensation pad, foot switch, electrodes and accessories necessary for general high frequency treatment.

Price and full detailed information will be sent on receipt of the attached coupon.

Sign and Mail the Coupon Now.

McIntosh Electrical Corporation

Successors to McIntosh Battery & Optical Co.

303 Fourth Ave. - New York
80 Boylston St. - Boston
Jenkins Arcade - Pittsburgh

Main Office and Factory
McIntosh Bldg.
225 N. California Ave.,
CHICAGO, ILL.

McIntosh Electrical Corporation

I would like to know more of your new Intermediate Type Hogan High Frequency Apparatus No. 8075.

Please send me full details, also copy of your Special Introductory Proposition.

Dr. .....

Address .....

.....

A.M.A.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Fourth of July Wounds

—and minor injuries at all times—are safely and quickly dressed with a

BAND-AID PROTECTIVE DRESSING

(a 1½ in. square pad of sterile gauze on a 1½ in. x 4 in. strip of Z-O Adhesive Plaster, ready for instant use.)

This unique dressing may be applied so as not to exclude air, a very important consideration where anaerobic infection is suspected, as for example, b. tetanus and b. welchii (gas bacillus).

Send at once for samples for possible use next week, or your patients may obtain a supply from their druggist

—and for finger injuries, scratches, and other very small wounds, there is a smaller size, admirably adapted. It is called BAND-AID.

If our medical friends who favor us with requests for samples, will further co-operate by stating the name of their druggist, they will make it possible for us to readily supply their future requirements.

Johnson & Johnson
NEW BRUNSWICK, N. J., U. S. A.

FORMIN
HEXAMETHYLENAMINE MERCK

Accepted by the Council on Pharmacy and Chemistry of the American Medical Association

When you prescribe "Formin" *you* choose the brand

When you merely prescribe "Hexamethylenamine" *someone else* chooses for you

Formin costs no more

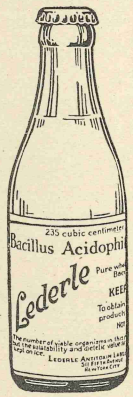
Merck & Co., New York

Bacillus Acidophilus Therapy

FOR changing the intestinal flora the Bacillus Acidophilus should be administered under conditions favorable for its implanation.

With large doses of an active culture in milk these conditions are met.

Milk contains lactose which provides suitable carbohydrate food for Bacillus Acidophilus.



COUNCIL ACCEPTED

Lactose is not readily absorbed during the early part of digestion and is carried to the colon where it is particularly desirable that the Bacillus Acidolphilus should proliferate.

Bacillus Acidophilus Milk
Lederle

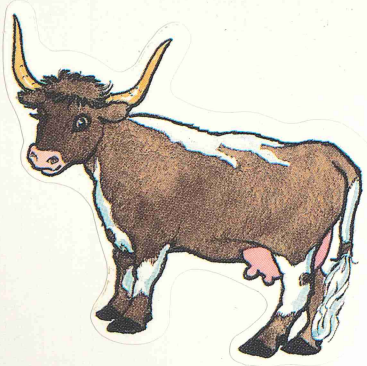
Is prepared from freshly isolated cultures which will insure maximum therapeutic results.

Full information on request

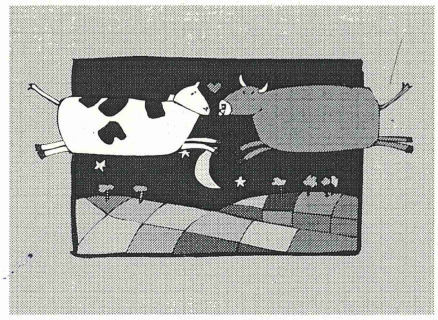
LEDERLE ANTITOXIN LABORATORIES
NEW YORK

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THANK YOU!!



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



AUCTION # 2121681584

ITEM: 1925 McIntosh Ad

DATE SHIPPED: 7-15-02

ENCLOSED IS THE ITEM YOU HAVE WON. IF YOU ARE SATISFIED, WE WOULD APPRECIATE RECEIVING POSITIVE FEEDBACK ON EBAY. IF YOU ARE NOT SATISIFED, PLEASE LET US KNOW.

THANKS,

LORI & RUSS ERICKSON
UFFDAHHH COLLECTIBLES
6403 KYLE ROAD
WESTON, WI 54476-4377

EBAY NAME: UFFDAHHH

Thanks William!

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

LA
2525 SOUTH MEADE STREET
DENVER, COLORADO 80219

May 31, 1994

Mr. William C. Wysock
Tesla Technology Research
2527 Treelane Avenue
Monrovia, California 91016

Hello Bill -

Hardesty sent to me the set of drawings for you Model 13M Magnifier Tesla Coil System. These drawings brought back a lot of memories. See enclosed construction drawings I made as a young man over 42 years ago for a Tesla $\lambda/4$ flat spiral. It was built (see enclosed photograph copy) and is now at the Museum of Wonderful Wireless in Minneapolis. I also hand wound a marvelous power transformer. It had four individually connectable secondary sections to give 50,000 volts with all four in (see enclosed photograph copy), and was placed in an oil bath tank. A lot of man hours on that baby! This too was given to the Museum but it may have been discarded by this time.

Those were the days. I was rather naive back then about the importance of the gap and about the length of conductor to yield a $\lambda/4$ setup, as my drawings reveal. And now, with all the knowledge I've since gained abut Tesla coil systems, I miss the hands-on-hardware days and the regular fragrance of ozone, but congratulate you all the more for your perseverance in engaging yourself in this fascinating work--going far beyond what I dreamed of 40 years ago and making it a business enterprise.

That 13M primary should give a **Q** value that's a real hum-dinger! Have you estimated what the coefficient of coupling will be for the 13M? I know it could be calculated from your dimensioned drawings because **k** is dimensionally linear, but I just don't have the time to do it now. Tesla thought he was operating rather successfully when he obtained an energy transfer efficiency of 85%, which requires a substantially greater **k** than the "critical value" giving only 50% efficiency.

If you aren't nearly completed on the 13M construction, I fear for your stress condition in attempting to meet the 1994 ITS Symposium date. Please take care of yourself.

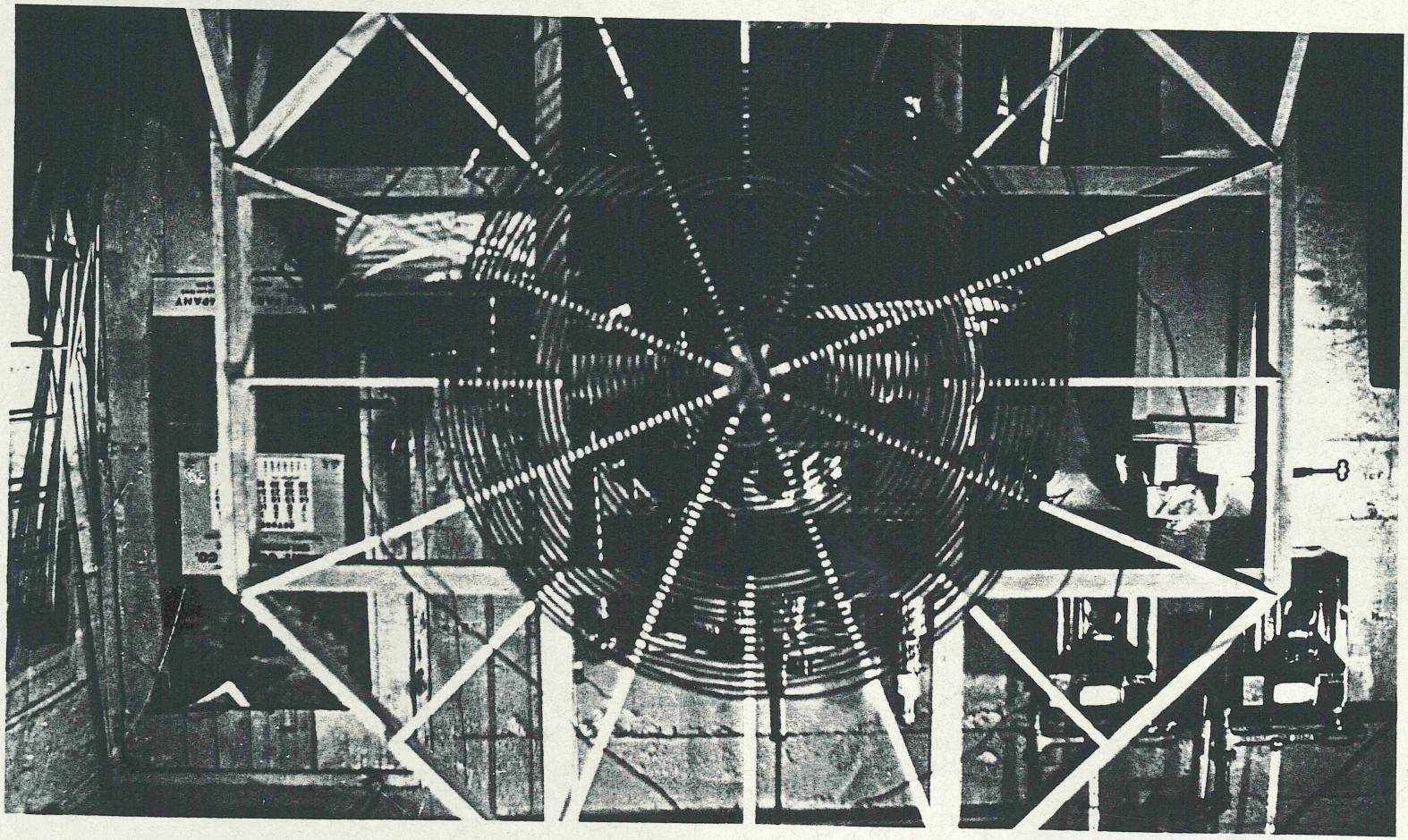
I just finished my second book on tesla's unpublished writings and am turning it over to my publisher. In it, Tesla further expounds on his philosophy of Tesla coil design and operation.

Warmest regards,

Lee

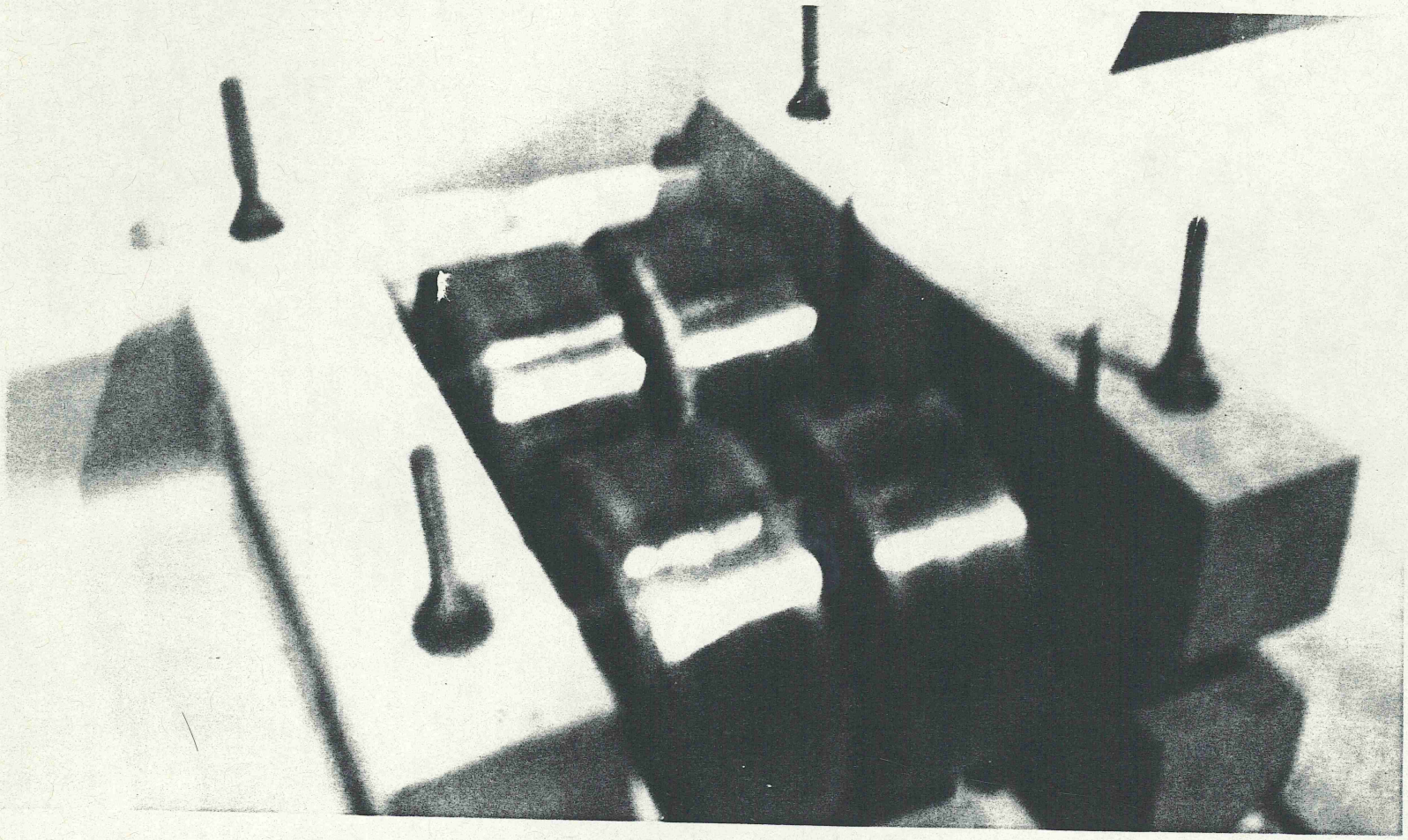
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



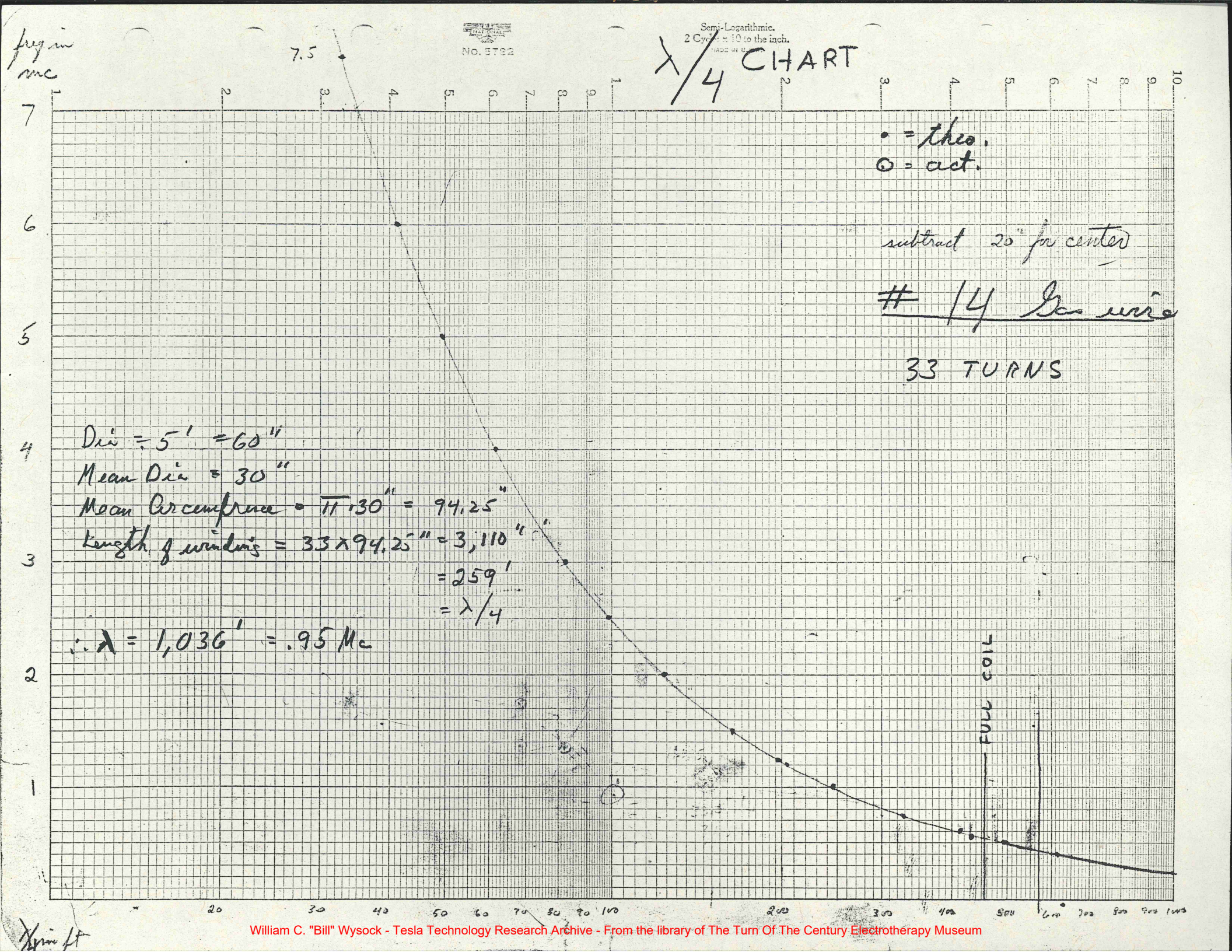
Half wand

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



4-sec. 50KV X-former — 5KW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

1/2 3

λ/4 OSCILLATION TRANSFORMER

NO. REQ.

(4) A — 25" — perf. 2½ × ¾

(4) B — 45° — 5' 10½" → + 1/32" — perf. 1 × ¾

(4) C + D — (60" − 2 × thickness of A)

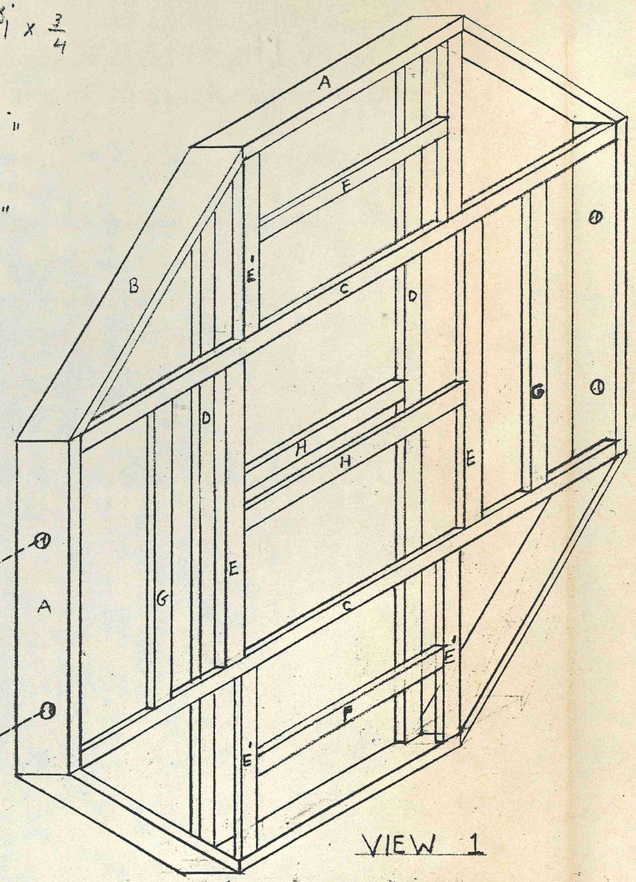
(6) E + G + H — SEE NOTE 1. — (25" − 2 × ht. of C + D)

(4) E' — 17 21/32 − thickness of A

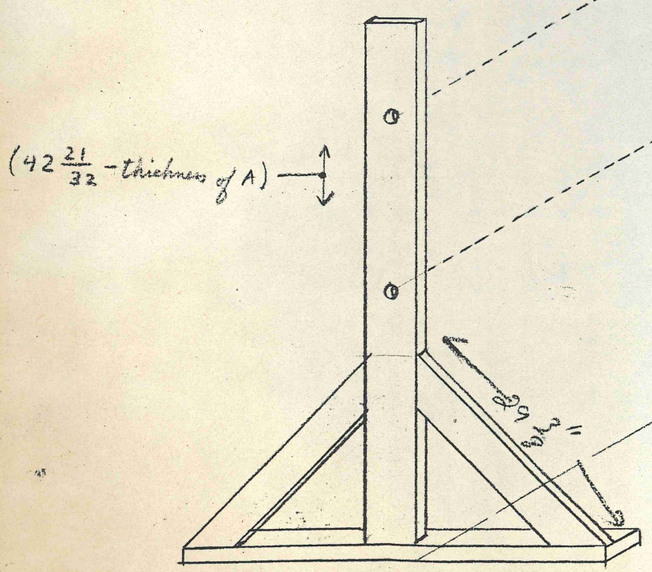
(4) F — 25" − 2 × ht. of A

2½ × ¾ → Tot ln. = 35'

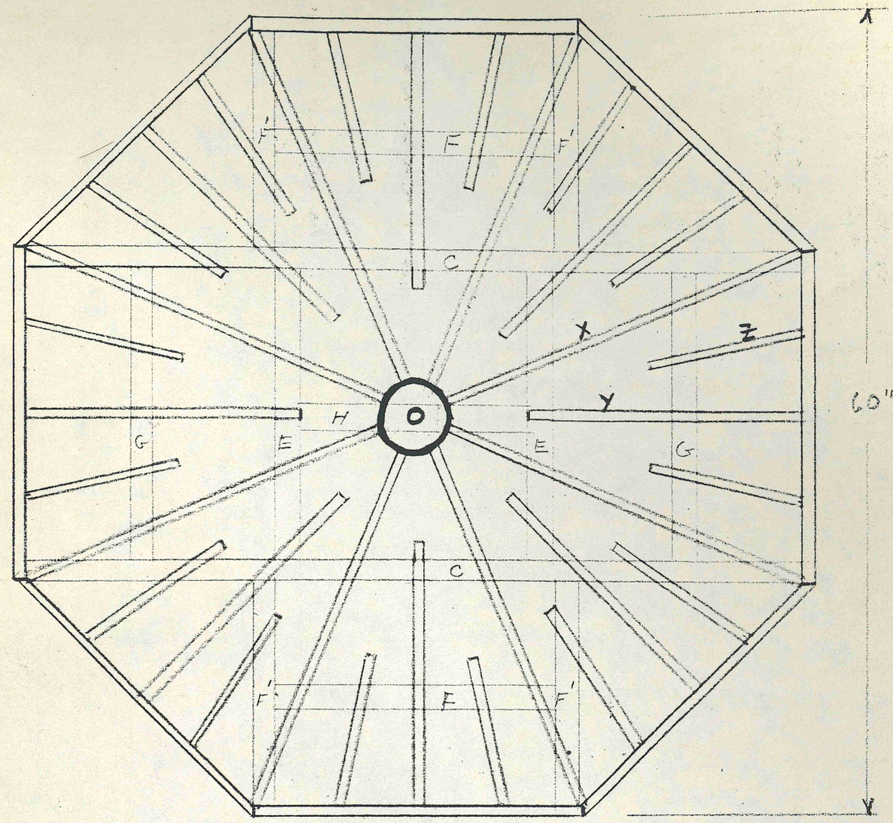
1 × ¾ → " " = 40'



VIEW 1



STAND



VIEW 2

(8) X approx. 32"
(8) Y approx. 22"
(8) Z approx. 12"
} perf. ⅜ × ¾

50' total

CHANGES

1. UPRIGHTS "E" MOVED TO INNER SIDE OF UPRIGHTS "E'." (SEE VIEW 2)
2. ADD "F" BETWEEN "D-D" DIRECTLY OPPOSITE POS. BETWEEN "E'-E'". (behind)

L2a
3-15-52

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

L. Anderson
7525 South Meade Street
Denver, CO 80219





MAY 31 1994
DENVER 802

MAY 31 1994
DENVER 802

Mr. William C. Wysock
Tesla Technology Research
2527 Treelane Ave.
Monrovia, CA 91016

FIRST CLASS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

FIRST CLASS

FIRST CLASS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



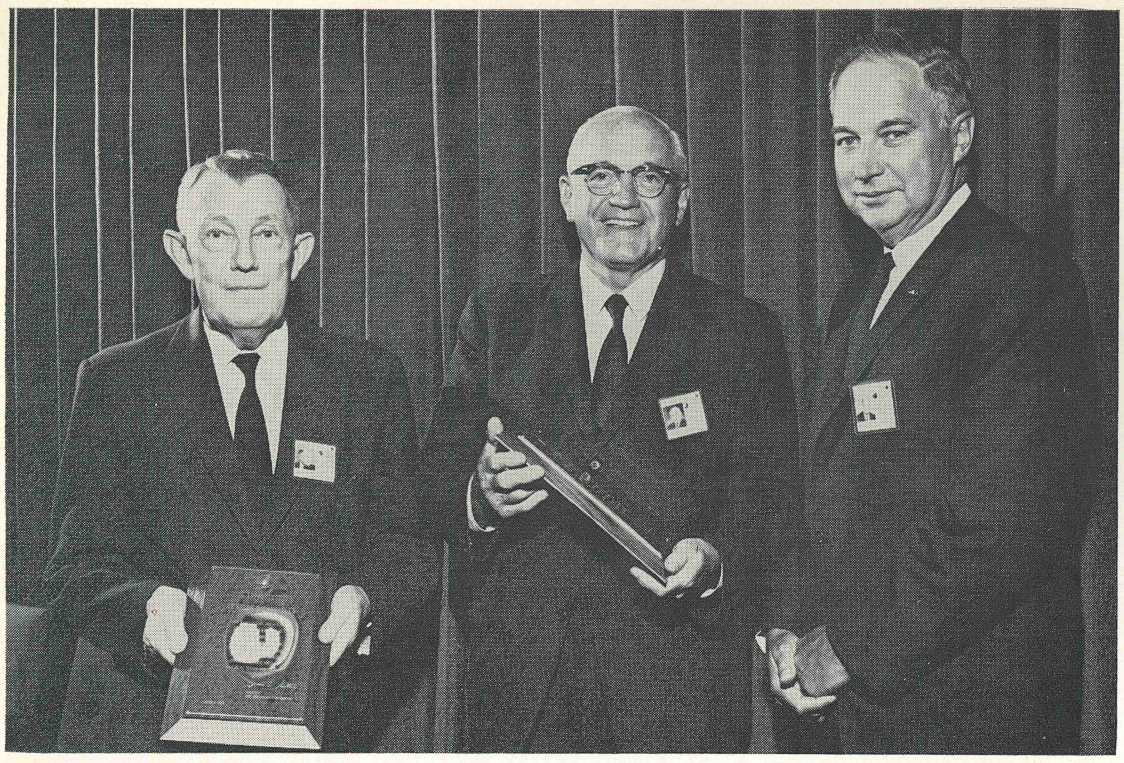
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



Left to right, Charles C. Lauritsen, vice chairman of the Board of Trustees and chairman of the Executive Committee, and Sherrod E. Skinner, Board chairman, accept — on behalf of the full Board membership — plaques presented by Dr. Ivan A. Getting. Plaques were given to present and past trustees in recognition of their significant contributions to the Corporation during its first five years.

Past And Present Trustees Are Cited For 'Wise Counsel'

Last Friday the 4th — the day Aerospace Corporation began its sixth year of service to the Nation — time was taken by our President, Dr. Ivan A. Getting, at the commencement of the meeting of the Board of Trustees to recognize the significant contributions made by these distinguished leaders from industry, education, science and public service to the Corporation during the first five years.

In a brief, informal ceremony, Dr. Getting presented engraved plaques to the Board members, noting that similar tokens of appreciation were being forwarded to past members of the Board. Sherrod E. Skinner, chairman; and Charles C. Lauritsen, vice chairman, chairman of the Executive Committee, and one of the three original Incorporators, accepted the plaques on behalf of the full Board membership.

The citation reads as follows: "In appreciation . . . . for wise counsel and strong leadership as a member of the Board of Trustees of The Aerospace Corporation during its critical first five years when the Aerospace concept of public service was being tested and proved. /s/ Ivan A. Getting President, The Aerospace Corporation."

Present members of the Board of Trustees are: Sherrod E. Skinner, chairman; Dr. Charles C. Lauritsen, vice chairman and chairman of the Executive Committee; Dr. William O. Baker, Gen. Lucius D. Clay (USA, ret.), Lt. Gen. James H. Doolittle, USAF, ret.), Dr. Clifford C. Furnas, Edward E. Huddleson, Jr., Maj. Gen. James McCormack (USAF, ret.), V. G. Nielsen, Gen. Earle E. Partridge (USAF, ret.), Arthur E. Raymond, Dr. Athelstan F. Spilhaus and Dr. Herbert F. York.

Former members of the Board, also recognized, Dr. Jerome B. Wiesner, Dr. Chalmers W. Sherwin, Roswell L. Gilpatric, Dr. Harold Brown, William C. Foster and Roger Lewis.

Aerospace Corporation was incorporated on June 3, 1960, but our first employees did not begin work until later. Plans are being made to recognize those employees by awarding the first Five Year Service Pins later this summer.

Savings Bond Drive Results To Date

With the Aerospace Savings Bond Drive extended a week, final results have not yet been tabulated. As of June 4, the statistics for each of the competing areas were as follows:

Administration Division — 78.3 per cent
El Segundo Technical Operations — 50.5 per cent
San Bernardino Operations — 49.3 per cent
Laboratory Operations — 38.6 per cent

The overall percentage of Aerospace employees signing up to buy bonds so far totals 55 per cent. This figure compares favorably with last year's 29 per cent mark, and results are still coming in.

Final returns will be announced in the next issue of the Orbiter.

the AEROSPACE CORPORATION Orbiter

Vol. 5/No. 12 June 11, 1965

On Fifth Anniversary

Words Of Praise To All GT-4 Launch Team Members

The totally successful launch of the Gemini-Titan 4 on Thursday, June 3, had more than the usual significance to Aerospace.

In a special News Flash announcement to all employees at general offices, Dr. Ivan A. Getting called it ". . . a specially-prized birthday present on the Fifth Anniversary of our incorporation."

Commending members of our Gemini-Titan II launch team for their outstanding performance, he said, "In a very real way, everyone of us privileged to work at Aerospace can share in the pride of this accomplishment in furthering man's progress into space.

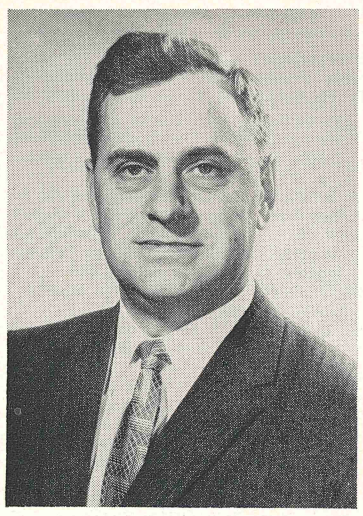
"Over the past five years, we at Aerospace have been called upon to perform in many important ways in the attainment of the nation's space and missile goals. Today's performance was but another step forward; we have demonstrated our ability to contribute significantly in these vital national programs. There remains much for us to do in the years ahead."

The Gemini 4 spacecraft was carried into space by the Titan II booster at 10:16 a.m. Five minutes later the mission Control Center reported the craft had been injected successfully into orbit on precisely the course sought.

Words of praise came to the Gemini-Titan II launch team, during a press conference which followed the launch of the GT-4. Christopher Kraft, NASA's mission director for GT-4, opening the press conference, extended congratulations to all the members of the launch crew for doing such a good job. Maj. Gen. Ben I. Funk, SSD commander, said he was "extremely happy" over the success of the launch and felt it appropriate to acknowledge the organizations responsible for the launch vehicle. He commended the Air Force team at ETRO and the personnel of the 6555th Aerospace Test Wing along with the "members of the industry team, which included Aerospace Corporation, Martin Company, Aerojet General, General Electric and Burroughs" for the teamwork they exhibited. "I am very pleased with the performance of the airborne vehicle," General Funk concluded.

In a telegram directed to Dr. Walter C. Williams, vice president and general manager of the manned systems division; Bernhard A. Hohmann, group director of the Gemini launch systems directorate and Dr. Robert Payne, director of the Aerospace ETRO, the Corporation extended "Congratulations on another success in the Gemini-Titan 4 launch today. Extend our congratulations to all Aerospace employees who participated." The message was signed by Dr. Ivan A. Getting, Dr. Allen F. Donovan and E. J. Barlow.

Dr. W. F. Leverton Is Elected Vice President



Dr. W. F. Leverton

Dr. Walter F. Leverton, general manager of the satellite systems division, has been elected a vice president of Aerospace Corporation by the Board of Trustees, it was announced this week by Dr. Ivan A. Getting.

Dr. Leverton joined Aerospace Corporation's engineering division in August, 1960. He was named general manager of the satellite systems division in Feb., 1964, when the El Segundo Technical Operations were reorganized. He will continue as general manager of the satellite systems division, which has the general systems engineering and technical direction of such prime space efforts as the military communications satellites, nuclear detection satellite and the Air Force world-wide satellite control network.

Before joining Aerospace, Dr.

(Continued on Page 2)

THE SECRETARY OF THE AIR FORCE
WASHINGTON, D.C.

June 3, 1965

Dear Mr. Skinner:

I want to express to you, and ask that you convey, my personal appreciation for the sense of responsibility to the public interest that Aerospace Corporation has demonstrated in connection with the recent hearings. There is no question in my mind that the essential soundness of the Air Force/Aerospace relationship has been reaffirmed, and even strengthened, as a result.

One such essential on which I place particular value is that of active and dedicated trustees. The outstanding scientific, industrial, academic, professional and governmental leadership that the Board brings to bear, individually and collectively, is assurance that Aerospace will continue to maintain the highest standards of achievement.

All those associated with Aerospace on this, the fifth anniversary of its formation, have reason to be proud of their contributions in furtherance of its unique and vital role.

My personal regards to you and the trustees.

Sincerely,

Eugene M. Zuckert

Mr. S. E. Skinner
Aerospace Corporation
P. O. Box 95085
Los Angeles 45, California

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Classified Ads

Classified ads are due in the Orbiter office by noon of deadline day, (Monday following publication). Deadline dates for the month of June are as follows:

June 14

Any special instructions regarding name or telephone numbers should be written on the ad form. Ads may be cancelled as late as Friday of the deadline week, but no additions or other changes can be made after the Monday noon deadline. For information concerning classified ads, call Eunice Pope, the Orbiter office, ext. 85445.

CAR POOL

RIDE WANTED from Manhattan Beach Blvd. and Crenshaw, Gardena. Carol, Ext. 87445.

CAR POOL or ride from Orange, on Cahpman or Katella Streets. Barbara J. Steere, Ext. 85421.

CAR POOL from Studebaker onramp of San Diego Fwy. to ESO. D. G. Toshach, GE 1-6287.

WANTED

TO RENT: 3 or 4 bdrm. home, Lakewood area. P. H. Young, 428-4225.

WOMEN HORSEBACK RIDERS for drill team, beginners preferred, Rolling Hills. Heather Malcom, 371-2142.

PORTABLE TYPEWRITER, good use, heavy duty. Walter Bochting, Ext. 30107.

FOR SALE—AUTOMOBILES

'65 VW, radio, ww, openable rear windows, near new, red, $1785. M. Rueda, 681-0141.

'65 MUSTANG 6 autom., white, wire wheels, transist. radio. Save Money. R. Ware, Ext. 88058.

'65 PORSCHE coupe, 4500 miles, make offer. Ray Kight, FR 8-5415.

'62 CORVAIR Monza Cpe., 4-speed, $895. R. Leatherman, Ext. 86420.

'62 FORD Conv., xlnt. cond., $1350. Beverly Nagle, Ext. 87940 or 391-8580 after 5 p.m.

'61 VW Sedan, radio, vinyl, clean, low miles, xlnt. cond. J. W. McCurry, FR 8-3520.

'60 CHEV V8, power SB, auto., clean, xlnt. motor, $895. Michael A. Ross, 677-0737.

'60 FORD Starliner, pwr, steering/brakes, radio, good trans., $550. H. Kent, 754-3343.

'59 OLDS, full power, good cond., take over payments. A Richardson, 379-1392.

'59 RENAULT Dauphine, clean, r/h, 35 mpg, xlnt. trans. car, $295. Wm. L. Schaeffer, 374-1221.

'58 CHRYSLER Windsor, clean, good engine/trans., take over payments. J. Marcoulier, Ext. 32450.

'58 PONTIAC Station Wagon, pwr. steering/brakes. As is, $345. Lt. Col. Skalak, 329-0782.

'58 CHEV Wagon, Msgt. B. J. Thames, 834-2468.

'55 FORD, 4 dr. wagon, good body, tires. Runs good, $200. Pete Ferry, FR 5-5629.

'55 CHEV, B/A, pwr. steering/brakes, 4 dr., V8, $200. Ann Rounds, 645-1945.

'53 MG-TD, beaut. restored, mech. fine, much new, $750/offer. Col. R. W. Yundt, 670-0039.

'50 CHEV, 2 dr., xlnt. trans., clean, runs good $110. Irvin H. Metz, VE 8-8868 after 6 p.m.

'47 FORD, near new motor, runs & looks xlnt., $425. Lt. Col. Martin, FR 8-1350.

'65 VW Variant S, 500 miles, AM/FM radio, vinyl, $2595. S. C. Freden, 376-7592.

'62 CHEV Impala, 4 dr. ht, AT&PS, white w/red int., $1495. R. Scurrah, 377-1333.

FOR SALE—MISCELLANEOUS

BOAT, 14′ runabout with 30 hp Evinrude, $295. Dale F. Gunn, FR 9-6703.

CABIN CRUISER, 20′ Glasspar, 2-45hp Mercury outboards, trailer, xlnt. cond. H. J. Tye, DA 6-9352.

12′ Lake or Duck Boat by Pioneer with overhead trailer, $105. Lt. Col. Skalak, 329-0782.

AIRPLANE, Comanche. Want 2 or 3 partners or will sell all. Autopilot, new paint, new periodic. Hap Hazard, Ext. 30735.

SURFBOARD, Velzy, 8′6″, like new, sell or trade for 9′ plus. A. Gillogly, 833-8434.

MOTORCYCLE, '56 BMW, good cond., $275. Rick Hamilton, 373-1288.

MOTORCYCLE, '64 - 80cc Yamaha, good cond., $265. David R. Collins, 376-1309.

DYNAMO Custom Ocean Rod Jigmaster reel, never used, $35. W. E. Brown, Ext. 87609.

DRAFTING MACHINE, Vemco — 12″&18″, mechanical engineers scale, board tilt control. Lt. Stephan G. Johnson, Ext. 31766.

HUBCAPS, 13″ Ford, spoke, $40; Inglewood Cheater Slicks, 700x14, near new, $45. Ferne Ortolino, 679-9197.

AIR CONDITIONER, auto Mark IV monitor xlnt. cond., $75. Stanley Furie, Ext. 30493.

TAPE RECORDER, Wollensak, stereo, model T-1515, sell or trade, good cond. J. A. Nicosia, DA 5-7068.

CAMERA, Polaroid, perfect, small size, almost unused, $22. Stan, 477-2493.

RADIO, Heathkit; Garrard changer; 4 - speakers; 25-watt amplifier; pre-amp, $150. Maj. Carl Hansen, DA 5-6896.

TRANSCEIVER, BC-645, new w/12V power supply. Geo. H. Sparks, Ext. 87877.

EXPOSURE METER, Weston Master III, like brand new, w/leather case, ASA ratings, $13. J. Kleissas, Ext. 88293.

TRAIN, American Flyer, 4′x8′, board layout, 8 cars, switch station, $60. Marion D. Brownsberger, 673-3903.

BANJO, 5-string, mylar head, new - cost $100; sell $75. W. Heller, Ext. 85800.

TABLE/4 BENCHES, Redwood, used one summer, xlnt. cond., $25. Sharron Stevens, Ext. 8036.

ENCYCLOPEDIA AMERICANA, Tate Series w/current annuals, never used, $225. Ida Schechter, 371-8953.

FREE Black Puppies, two weeks old, male or female, D. Medeiros, OS 5-6649.

TROPICAL FISH, 2 large, very rare, $150 and $250. D. W. Greenlund, NE 9-1253.

FREE KITTENS, male, 5 wks. old. A. Vampola, 373-1466.

AIR LIFTS, model A, used but still in warranty, $15. G. W. Rohrer, 349-1485.

SKI BOAT, 14′ Bellboy w/35hp Evinrude engine & boat trailer. Bob Alegria, TE 0-3633.

FOR SALE—REAL ESTATE

4 BDRM, 2-½ ba, custom-blt. home in Tree area P. V. Estates, 5-¾ loan, by owner, $43,900. Lt. Col. W. Penn, 375-4592.

4 BDRM, fam. rm., 1-¾ ba, xlnt. neighborhood, Gardena, $26,500. Maj. C. Ward, NE 5-0721.

4 BDRM, den or 5 br., f.r., Manhattan nr. beach/schools, 2450 sq. ft., 2-½ ba. A. Bakst. 374-4840.

4 BDRM, 2 ba, combined kit./fam. rm., blt-ins, cpts/drps, fenced, ldspd., freshly painted, ocean view, 5 min. to shopping/schools/new college, 3 yrs. old, $34,500. Col. McCormick, 377-1028 or Ext. 30533.

4 BDRM, 1-½ ba., blt-ins, 2 patios, ldscpd., fenced, bkyard, Simi, $19,800. Iva Heins, (805) 526-6832.

3 BDRM, 2 ba, partly furn., blt-ins, $29,000, 5409 W. 123 Pl., Hawthorne, Jack Simpson, OS 6-0475.

3 BDRM, blt-ins, den, cpts/drps, din. rm., June occupancy. Lt. Col. E. George Wale, TE 1-5373.

3 BDRM, 1-¾ ba, close to S. D. fwy., UCLA, W. Los Angeles, $36,500. Paul Kisliuk 473-7613.

2 HOUSES: 1 - 3 bdrm., 1 - 2 bdrm, on same lot, $22,950. Andrew Kosek, PL 5-7490 after 5 p.m.

5 ROOM home, fully carpeted, 1¾ bath, sacrifice. Msgt. B. J. Thames, 834-2468.

40 ACRES, near 29 Palms, $5,000. Norman Millard, GR 2-0304.

3 BDRM, 2 ba, blt-ins, dishwasher, 2 car garage, fenced, ldscpd., immaculate, $32,500. Lt. Col. T. P. Martin, FR 8-1350.

FOR RENT

4 BDRM, 2 ba, ww cpts, close to S. D. Fwy. 6832 Alexandria Dr., Huntington Beach, Cal. $175. Com John E. Kennedy, (714) 897-7790.

4 BDRM, 2 ba, dbl. garagee, $150 mo. Norvill Robinson, 756-6714 after 5 p.m.

3 BDRM, 1-¾ ba. house, Hollypark, patio, 2 car garage, swimming pool, gardner. F. C. Wallraff, GL 7-2874.

2 BDRM apt., large, modern, cpts/drps, West L.A. Gladys Hammond, EX 7-5417.

1 BDRM. unfurn., near here, carport, ldry. facilities. M. Webster, 322-3441.

1 BDRM apt., unfurn., blt-in stove, cpts/drps, near shopping/Aerospace. A. Sirotnak, 675-1241.

1 BDRM. apt., lovely unfurn., c/d, s/r, beam ceilings, $115. West L.A., near fwys. H. Sommers, 836-4880.

1 BDRM apt, lovely, furn., behind Plush Horse, swimming pool, rec. room. Sally Giacobine, FR 8-3614 eves. or FR 8-2268 days.

1 BDRM, furn., 1 block to beach, Hollywood Riveria, adults, $125 month. R. L. North, 377-2992.

MOUNTAIN CHALET - 360° view, sleeps 6, reserve wk. or wkend. Walter F. Kindt, 679-9196.

UNFURN. APT., ldry. facilities, garage, El Segundo. Chuck McDonald, EA 2-3591.

APT., large ocean view, Santa Barbara, furnished, $50 wk. J. E. White, 324-3204.

2 BDRM Cabin, sleeps 6, completely furn., ideal location, Big Bear. Sallie Wagner, 379-4557.

FURNITURE & APPLIANCES

GAS RANGE, Wedgewood w/grill & double oven, $65. Edmond P. Fawaz, 376-6281 eves.

GAS RANGE, Table Top, 40″, older deluxe model, $25. Warren J. Dowell, 645-1193.

STOVE, apt. size, $10. Doris Gadlin, Ext. Ext. 85200.

WASHER/DRYER, Norge, new deluxe models, retail $520 - sac. $395. Dwight Baird, FR 6-4290.

FREEZER; T. V., Dinette, Studio Couch, Air Conditioner. Msgt. B. J. Thames, 834-2468

CATALINA TRIP COMING JULY 10; TICKETS ON SALE

Tickets are still available for the AEA's moonlight cruise to Catalina on Saturday night, July 10.

Highlights of the evening include sailing on the Big White Steamship from Wilmington at 7:30 p.m., cocktails and dancing aboard ship during a two-hour cruise, and a party at the Casino Ballroom at Avalon. The return cruise departs at 12:45 a.m. and arrives at Wilmington at 2:45 a.m.

Tickets for the cruise are selling at the group rate of $5.50 round trip. Admission to the dance at the Casino Ballroom is $2 per person, while $3.75 per person will include a buffet dinner at the Casino along with the dance.

Tickets are available from all receptionists and from personnel services, Bldg. A2, room 1059. Tickets are also on sale at the personnel services office in San Bernardino, and by Pat Stewart, room 2004, bldg. A1, general offices.

Ticket sales will terminate as of July 2, so everyone interested is urged to buy their tickets as soon as possible. Only a limited number are alloted, and no more will be available after they are sold.

Remember:
Catalina Trip,
July 10;
Night At
Disneyland,
October 16

T. V., 21″ Zenith, blonde console, $39; Twin Beds, $15 each. Guy P. Buck, FR 1-6387.

RECORD CABINET, mahogany, 30″Lx17″-Wx30″H, $10. E. R. Berry, 378-3704.

DREXEL BDRM: 8-drwr plus matched 6-drwr and man's valet, xlnt. R. Z. Weitsman, Ext. 86730.

REFRIG., nice clean apt. size Hotpoint, $60. R. Simons, 375-9565.

SAN BERNARDINO ADS

FOR SALE

'64 PONTIAC Grand Prix, pwr. brakes/steering, beautiful condition. V. Carrigan, Ext. 1301 or TU 2-6112.

'60 MGA Roadster, light blue, xlnt. cond., wholesale price. W. H. Emrick, 792-6556.

'57 FORD Station Wagon, V8, r/h, good cond., $375. Vikki Fitzgerald, 796-0820.

'52 JAGUAR, recently restored, wire wheels, new top/paint/tires. Asking $750. A. J. Leiher, 862-0343.

FORD V8, stick, Fairlane 500, 2 dr., $500. E. Despars, 792-9255.

TRIUMPH TR-4, r/h, michelin tires, xlnt. shape, $1495. Capt. Gary McLeod, TU 2-9791.

REFRIG., Hotpoint, pink, '63, 18 cu. ft., bottom freezer, $200. Avail. June 30. F. W. Erickson, 335-6272.

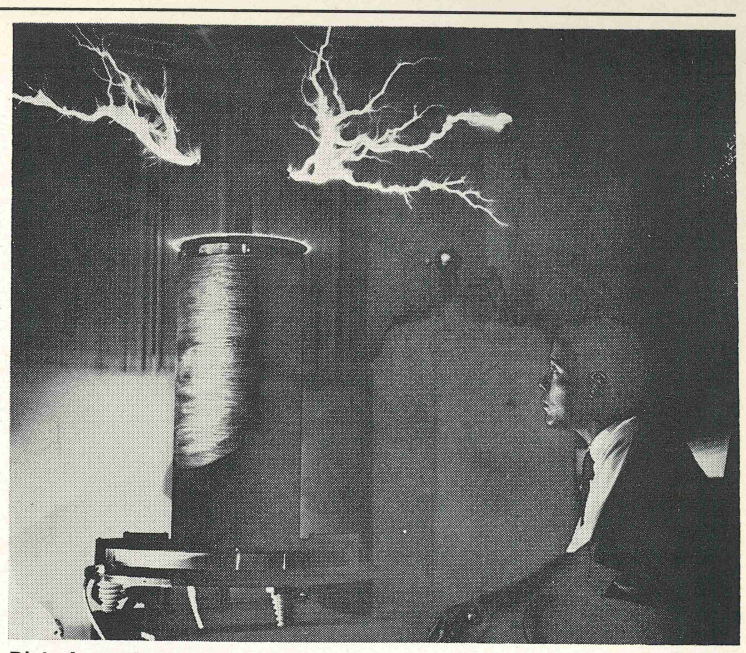
KITTENS, 2 Persian, sandbox/saucer trained, would love good homes. Ann Berry, TU 3-2674.

SCOTCH COLLIE, AKC registered for stud service. J. W. Bond, TU 2-3148.

COMPACT deluxe Webcor tape recorder, like new, $70. A. W. Fortuno, ext. 1061.

CAR POOL

INTERESTED in joining car pool to West Covina, Covina area. Abraham Zukerman, ED 1-5232.



Dick Aurandt demonstrates the high voltage electrical device which he keeps in a spare bedroom at home. The Tesla coil puts out over a million volts at three KVA.

High Voltage Electrical Devices Highlight Home of Dick Aurandt

If you visited the Torrance home of lab analyst Dick Aurandt, plasma research labs, you might be startled to see how his interest in electricity extends into his home. Aurandt enjoys showing visitors a spare bedroom in which he keeps a Tesla coil, which puts out over a million volts at three KVA.

Aurandt, interested in high voltage electrical devices for years, has loaded his house with such equipment for as long as he can remember. The present equipment, which he built after high school graduation, formerly was put to use as he put on programs in schools throughout the Southern California area, which in 1951 resulted in an honorary membership in the American Association of Physics Teachers.

Because of other commitments Aurandt turned down an offer from the Moody Institute of Science to tour nationally for them. However, his creation did enjoy wide public exposure when it was used in a "Frankenstein" movie, in the laboratory where the monster was created.

"My wife's used to me and my nutty hobbies," Dick laughed. "Before we moved to our present house we had a smaller place to live so all the equipment was kept in our bedroom. But this is just one of my hobbies, and it must really have given our new neighbors a turn to see us moving in. We had the electrical equipment, including three three kilowatt oil-filled high-voltage transformers; my racing motorcycles, an Aeolian Duo-Art player piano (electric) and 200 piano rolls; and our Model A Ford."

The Model A is "the best car I ever owned," Dick said. "I used to commute from Pasadena in it, and I spend less time on it than any other car I've had. I rarely have any mechanical trouble, and it's simple to fix if it needs anything."

His two speedway racers are the most time-consuming of Dick's hobbies. He enjoys motorcycle racing thoroughly, and has raced for the past ten years. This includes racing every Friday night at the Ascot Speedway, the annual national race, and racing at other tracks within weekend driving distance.

His enthusiasm has remained undimmed through numerous accidents resulting in nine concussions, a broken neck, broken ribs, and other assorted injuries. These came in spite of the leather padding from head to toe, crash helmets, and face guards that the racers wear.

In addition to his love for racing itself, Dick works on his cycles constantly during the week.

"What it all boils down to," he explains, "is that I'm a mechanic . . . . I like to build things. I studied electrical engineering at L.A. City College, then spent three years working on the 32 M.E.V. linear accelerator at U.S.C. The work I do here in electronics is so enjoyable to me that it's like having another hobby! Then there are off-hours electronics puttering, working on the cycles, fixing up the Model A, and keeping up the old player piano. These are all part of the fun of getting in and making things tick."

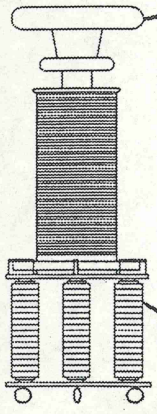
AEROSPACE CORPORATION
P. O. Box 95085
Los Angeles, Calif. 90045

Nonprofit Org.
Bulk Rate
U. S. POSTAGE
PAID
El Segundo, Calif.
Permit No. 125

RETURN REQUESTED

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

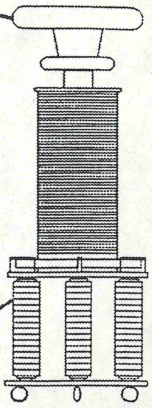
Tesla Technology Research



Manufacturer of the
Worlds Largest Tesla
Coil Systems - Over
200 Units Worldwide

est. 1975

Magnifier Systems
to 25 Million Volts
Coils for Research
Industry, Display

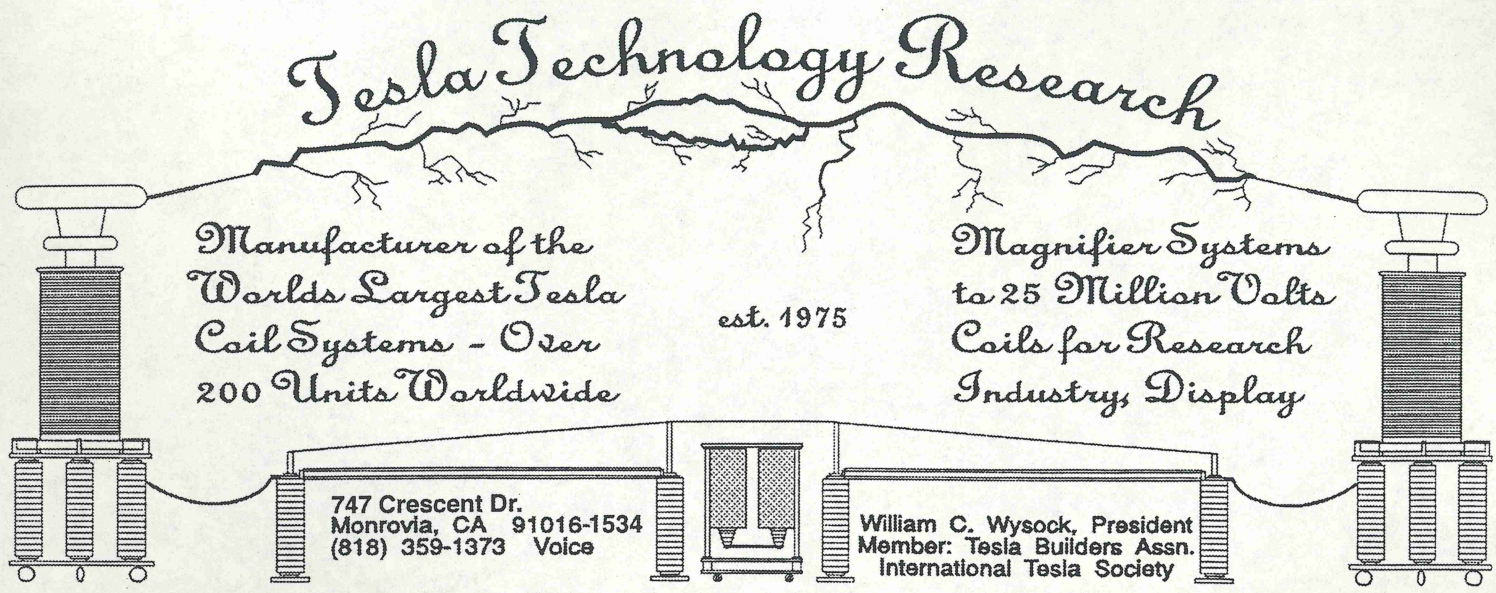


747 Crescent Dr.
Monrovia, CA 91016-1534
(818) 359-1373 Voice

William C. Wysock, President
Member: Tesla Builders Assn.
International Tesla Society

Model 12 Dual Tesla Coil - 6.5 Million Volts - Colorado Springs - July 1992

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



1.) INTRODUCTION AND BACKGROUND: DESIGN OF MODEL 14M MAGNIFIER.
DESIGN OF MODEL 13M MAGNIFIER.

2.) ATTEMPTED EXHIBITION OF 13M AT COLORADO SPRINGS, JULY 22, 1994.

3.) FUTURE PLANS AND FURTHER MODIFICATIONS OF THE 13M MAGNIFER.

4.) QUESTIONS AND ANSWERS.

5.) EPILOG: A PERSONAL OPINION; WILL WE ALLOW HISTORY TO BE REWRITTEN?

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. Wysock-N6UXW
Tesla Technology Research
747 Crescent Drive
Monrovia, CA 91016-1534
(818) 359-1373

DESIGN, CONSTRUCTION AND TESTING OF A LARGE SCALE MAGNIFIER-TYPE TESLA COIL SYSTEM

"I actually used in all these three forms, almost every day, all these devices; and furthermore, I had other methods which are not yet patented, and those are corking fine methods." N. Tesla. [4]

1.) INTRODUCTION AND BACKGROUND.

In January 1994, the design for a scaled version of Tesla's famous 1899 Colorado Springs magnifier coil was conceived. The goals were to use modern construction techniques and materials as an integral part of the overall coil design, seek financial sponsorship to assist in funding the projcet, and finally, build and test the system in time for exhibition at the 1994 International Tesla Symposium. The origional design for the Master Oscillator, (Tesla primary and secondary coils), was to be a multi-layerd archimedian flat spiral that would be 20 feet in diameter. The framework supporting these two coils was to be made of fiberglass and form a framework that could be bolted together on location, and would elevate the horizontal plane of the primary and secondary coils 20 feet high above ground. The electrical and physical advantages of this design over Tesla's 49.25 foot diameter helical-wound primary and secondary coils as used in 1899, are well known. Even Tesla had previous practical experience with this form of r.f. transformer winding technique, as witnessed from photographs in his Houston Street laboratory prior to the Colorado Springs development work, and again at Wardenclyffe; Tesla used flat spiral transformer designs. These advantages are the ability to control the voltage gradient distribution along the secondary winding, and an improved coupling coefficient between the primary and secondary, where the primary is wound about the circumference of the outer diameter of the secondary coil, which is the ground point of the secondary. This places the largest amount of secondary coil inductance in a closer magnetically coupled influence of the primary winding, thereby increasing mutual coupling between the two windings, producing higher energy transfer efficiency.

In a high frequency, high voltage transformer, E-field or voltage gradient control becomes a serious concern. Corona losses need to be eliminated or minimized in order to to achieve maximum transformer efficiency. In a flat spiral secondary construction where the low voltage or ground point is at the periphery, the high voltage point will be at the center of the spiral. The electromagnetic fields set up in this type of winding produce a Faraday shielding effect on successive turns, reducing stray corona leakage. In Tesla's early development work, this form of control was experimented with, as well as other methods, such as enclosing the entire transformer in oil. It is interesting to note that the modern-day automotive ignition coil (for which Tesla received a patient,) combined the attributes of a primary winding around concentric layers of secondary windings, the high voltage end of which is at the center of the winding, and is electrically connected to a silicon steel laminated core. This core material increases the permeability of both windings and, along with the whole assembly being contained in oil, provides a design of smallest size and highest efficiency.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

In a Tesla transformer of much higher input power and size, it becomes impractical to employ oil or any ferrous core material. However,the fore-mentioned coupling efficiency of the concentric layer approch with the high voltage end at the center of the construction, becomes a very attractive design feature. The origional design for a scale version of the 1899 project using this principle was presented to prospective financiers in February, 1994. It was deemed too expensive and physically large to handle, within the time and budgetary constraints that were imposed. Thus, Model 14M, as this design was dubbed, had to be shelved. In its place, an even smaller design Master Oscillator was substituted of much the same construction as Tesla utilized in 1899. This second design would be 1/5 scale in size and amount of inductance in the primary and secondary windings, as compaired to Colorado Springs. The secondary winding would therefore be a single layer helical winding on an open framework. Wood was substituted in this new design instead of fiberglass, in order to further reduce anticipated construction costs. Of all the available types of wood, Sitka spruce was the most desirable (and expensive!) This is the same type wood that large power transformer manufacturers utilize as coil supports in their construction. This wood comes only from Alaska and sells for about $3.00 per linear foot. The physical and electrical attributes of this type of wood are that it is a straight-grained closed-cell growth dense wood, and when properly kiln dried and varnished, makes an excellent insulation support material that is easily machinable, with a low dielectric loss tangent, even at moderately high frequencies and very high voltages. More then $4,000.00 of this material was procured for use as the Master Oscillator upright supports, and the squirrel cage structure for the tertiary or Extra coil form. The lower support framework supporting each coil structure was made from clear Douglas fir and pine wood.

The 1/5 scale version Master Oscillator design was to employ a moderately high degree of mutual coupling between the primary and secondary windings, due to close physical spacing, and decoupling both windings from excessive loading against the ground plane, by physically elevating both windings. The high value of M (mutual coupling), implied a need for a very short dwell or commutation time of the rotary spark gap, or "rotary break," as Tesla referred to in his Colorado Springs diary notes. The commutation time that was determined as optimal, was on the order of 15 microseconds. Designing and building a rotary gap to handle very high levels of input power and voltage, yet provide very short pulse durations, proved to be sizable design challenges.

The inital concept for the rotary gap centered on the use of a salient-pole syncronous motor. The origional planned A.C. power input level was to be on the order of 50 KW, with a tank circuit charging voltage up to 60 KV. In order to handle high power and voltage levels, yet produce very short commutation dwell times, the physical size of the spark gap was dictated by the rotating velocity required of the rotary electrodes. These electrodes were configured as dual pairs of 0.50 inch diameter thoriated tungsten round rods with hemi-sperical ends, mounted in the ends of a pair of aluminum rotating arms on a common dirveshaft. The stationary electrodes were also dual pairs of the same construction, placed 90 degrees apart at fixed locations around the rotary arms. The geometry of the electrodes with their hemispherical ends and a design speed of 3,600 r.p.m. on the driveshaft, determined the radius of rotation needed to achieve a mechanical dwell duration that approched the origional design goal of 15 microseconds. This design had to be compromised somewhat, due to the cost of materials and manufacturing, and practical limitations of available torque from the drive motor, to turn the driveshaft and rotary arms at a speed of 3,600 r.p.m.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Two design apporches to couple power from the motor shaft to the driveshaft were considered; direct-coupled insulated shafting and positive drive belting on electrically and mechanically decoupled shafts. The latter was chosen for the advantages of reduced size and fewer mechanical design problems. A flat positive drive timing belt with a 10 horsepower at 3,600 r.p.m. rating was obtained and phenolic positive drive pulleys for both the motor and rotary arm shafts were fabricated, as well as a phenolic idler pulley to take up torque induced slack on the return side of the belt. This belt exhibits sufficient electrical insulation qualities such that the leakage current to ground from the rotary arm driveshaft is limited to about 3.5 milliamps with 50 KV on the rotary arm driveshaft.

The rotary arms were sized to rotate about a 24 inch diameter circle, circumscribed by the hemispherical tips of the tungsten rotary electodes. This arrangment limits the spark dwell time from the rotary electrodes to each group of stationary electrodes to the order of 25 microseconds at 3,600 r.p.m. To further reduce spark dwell time, the enclosure housing of the rotary gap was designed to be pressurized with nitrogen gas up to 30 p.s.i. One inch thick clear plexiglas sheeting was chosen for the enclosure material, which offered the advantages of ease in machining, mechanical strength, and the ability to visually observe the performance of the gap while energized.

The origional design capacity for the resonant tank circuit consisting of a capacitor bank, rotary break, and Master Oscillator primary inductance was 0.16 MFD at 50 KVAC-RMS, from four Cornell-Dublier phenolic case pulse units that were obtained surplus. It was not known what dielectric material was used in these units; i.e., mica, mylar or other type of plastic film. The ESR (equivilent series resistance), was measured and the dissapation factor of each unit was rated at 0.36. Additional capacitors were made available to allow for testing with different values of primary tank capacity.

The Master Oscillator primary inductance is constructed from two parallel-connected single turn coils of 500 MCM welding cable, and placed about the periphery of the Sitka spruce upright supports, that form the framework for the secondary coil. The primary coil is 12 feet in diameter, and the center-to-center spacing of the two single turns is set at 4.5 inches. This same type cable is used exclusively for all inter-connect wiring, along with 4 inch wide copper straping for the capacitor bank. The coil form made of Sitka spruce, is supported on a framework of clear Douglas fir framing, elevated 4 feet above ground on 4 porcelain pedistal type insulators. The radius between the vertical centerline of the primary and secondary windings is set at 12 inches. However, provision is made for reducing this distance. The vertical offset between the horizontal centerline of the primary to the first turn of the secondary winding is set at 2 inches, and is also designed for adjustment. The secondary winding consists of 30 turns of mil-spec #4 AWG stranded insulated cable with a 105 degree C heat rating. These turns are spaced 1.8 inches apart, and the diameter of this helical winding on its Sitka spruce squirrel cage form set at 10 feet. The final top turn is connected to a toroid capacity terminal ring 10 feet, 8 inches in diameter, with a cross section of 4 inches. This ring is fabricated from smooth outside wall, light galvanized flexible steel tubing. The toroid ring serves two purposes; to provide an electrostatic capacitive load to the output of the secondary winding and to eliminate the possibility of corona streamer leakage. The transmission line or interconnecting link between the output of the secondary winding to the input of the Extra Coil, is also made of this material. The transmission line is 45 feet in length, the distance between the facing sides of the two coil assemblies. The design of the Master Oscillator coil has proven most effective and satisfactory in all operations.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The Extra Coil which is treated as a self-resonant inductance, utilizes the same construction and materials as in the Master Oscillator. The helical coil form is fabricated from Sitka spruce and three 5 foot diameter fiberglass flat discs. The coil form is 5 feet in diameter and 10 feet in length. 150 turns of #8 AWG mil-spec insulated stranded cable are wound with a spacing of 0.8 inches per turn. 4 inch diameter flexible steel tubing form corona supression toroid rings and are used as both the first and last turn of the inductance on this coil. A phenolic tube spacer 3 feet in height and 2 feet in diameter is used to support the main toroid discharge terminal. This terminal is hollow spun aluminum, 8 feet in diameter and 30 inches in cross-section. The Extra Coil is supported on a douglas fir wood framework and mounted on a porcelain insulator stand 6 feet 4 inches in height. The overall height of the Extra Coil assembly is 20 feet 4 inches or 6.2 meters.

The origional high voltage power supply transformer was nameplate rated as a 25 KVa unit, with tap positions on the low voltage winding corresponding to an output voltage up to 60 KV. The construction of this unit was thought to be conservatively built such that for short periods of operation, its KVa rating could be increased two fold, to 50 KVa. In the origional testing of this system at Southern California, it was discovered that indeed the core of this transformer went into complete saturation above the 25 KVa level. Therefore, all of the first (alpha) tests conducted on this system were limited to a maximum a.c. input of 25 KVa. These tests took place between July 16-18, 1994. Due to the shortness of available time, the initial proof-of-performance testing was all that could be accomplished, prior to loading the entire system into a 51 foot long 10 foot high container, for transport to Colorado Springs.

The equipment arrived at Colorado Springs at 9 p.m. on July 20, 1994. The intended exhibit site was to be an outdoor equestrian area known as Penrose Stadium. Setup of the equipment commenced at 7 a.m. on July 21, and the date for exhibit was set as Saturday, July 22. A seperate power supply transformer was ordered from a firm in Arkansas, and was scheduled for arrival on July 20 at the exhibit location. This second transformer is a 100KVa unit that stands 8 feet high, weighs approximately 2,500 pounds, and is rated for 240/480 low voltage and 36 KV high voltage. To energize this unit, the ITS planning committee arranged to have a 138 KVa stepdown transformer on location, to connect the stadium's mains at 480 volt down to 240 volt, which is the required input voltage for the custom made 2-bay rack cabinet power supply controller. The physical setup of the Model 13M system requires a work crew of 6, a fork lift, a bucket truck, and a crane. It requires approximately 8 hours, simply to accomplish the physical construction of this equipment. In a large apparatus such as 13M, electrical characteristics and tuning are always widely influenced by the surrounding immediate invironment. The reflectivity and conductivity of Colorado's red clay-like earth behaves very differently as compared to the asphalt surface of the (alpha) test site in Southern California and represented significant tuning changes. Perhaps most importantly, the integrity of a master ground reference for the input of the Master Oscillator's secondary coil, was questionable. At the (alpha) test site, the location of a 50KW A.M. radio transmitter installation, with its vast ground point and radial counterpoise system feeding a 5 tower phased array, was available for a master ground reference. At Penrose Stadium, only a series of galvanized steel posts as perimiter fencing was accessable. No ground resistivity tests were possible at either location, due to the short amount of time available. At Penrose, all the equipment was set up on sheets of 3/4 inch thick, 4 foot by 8 foot plywood, which lay upon the dirt surface of the stadium floor.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MURPHY'S LAW AND OTHER ANOMALIES.

The equipment setup started the morning of July 21 at Penrose Stadium. NOAA weather servies as well as the Air Force base weather data forecast mild temperatures and light wind conditions. All of the equipment was [finally] ready for initial power-up testing as of 11 p.m. The night sky was clear and the temperature had dropped into the low 70's. The rotary gap motor which is slowly raised from 0 up to the running speed of 3,600 r.p.m. by means of a 15 KVa autotransformer, was energized. As the rotary gap approched about 1,800 r.p.m., there was a sudden violent vibration observed, and the emergency E-stop control was activated. A close inspection of the gap showed that the 10 h.p. motor was loose on its mounting bolts, causing the positive drive belt to skip as the motor was physically raised up off its mounts by the increase in torque. This in turn, caused the thoriated tungsten rotary electrodes to come in distructive contact with the stationary electrodes, shattering six of these $200.00 rods. In an emergency attempt to salvage what was left, the plexiglass housing had to be field-stripped, the sheared-off electodes removed, the rotary arms re-balanced with only single electrodes in their two ends, the debris removed from the interior of the 1 inch thick enclosure, and then reassembled. At about 2 a.m. on Saturday July 22, the system was finally ready to be tested.

Several important changes were incorporated in this [beta] test; 1) The origional 25 KVa transformer was now replaced by a 100 KVa unit. 2) The mains source could supply up to 138 KVa, instead of only 50 KVa, the limit at the [alpha] test site. 3) For the first time, the use of nitrogen gas to reduce spark gap dwell time, by pressurizing the rotary gap enclosure up to 15 p.s.i., was included. As the system was powered up [successfully] for the first time and slowly raised to about 80 KVa input, long streamer discharges were observed emanating from the 8 foot diameter toroid discharge terminal. These appeared to approximately 25-30 feet in length. Also observed were several heavy [D'Arsonval] type discharges about 8 feet in length, going from the trans-mission line to ground, at a point approximately 15 feet before the input to the Extra Coil. This was the same type phenomena shown in photographs of Tesla's 1899 machinery. This power-up test lasted for about one minute. The system was then powered down and the equipment inspected. The rotary spark gap enclosure exhibited a dark orange-yellow color to its interior; the result of the nitrogen gas recombining into nitric oxide. As the work crew approched the location of the spark gap for a closer look, the plexiglass enclosure began to develop a large quantity of heat stress cracks at most of the 3/8-16 threaded bolt centers; the result of intense temperature difference between the interior and exterior of the enclosure. It was estimated that the interior temperature had raised over the one minutes' operation at the 80 KW level, from ambient to above 400 degrees F. This observation was validated by virtue of the fact that the phenolic plates that locate the stationary electrode assemblies around the rotary arms, were bubbled on their surfaces and exhibited resin seepage. This observed condition had not been previously encountered at the [alpha] test site undoubtedly because of the significantly lower input power level. Since the system appeared to be usable, in spite of the setbacks encountered, it was decided to stop work for the night and make additional repairs to the rotary gap later in the morning. Several members of the ITS staff volunteered to keep watch over the equipment for the remainder of the night.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THE "FIFTY YEAR STORM" AT PENROSE STADIUM.

At 9 a.m. July 22, a local machine shop was contacted to provide six centerless ground 0.5 inch diameter replacement electrodes with hemispherical ends. These were only available in tungsten-carbide instead of thoriated tungsten. The top plexiglass enclosure plate had been removed and machined so that three venting holes could be bored, to increase hot air exhausting from the gap enclosure interior. As the work progressed, the skies over Colorado Springs became overcast and it began to sprinkle. A check with the weather services indicated a "slight" low pressure front was moving through the area and the updated forecast was for clearing by afternoon. As the noon hour approached however, this "slight" weather front had intensified and became a catagory 1 force storm with gail winds sustained above 70 m.p.h., intense lightning, hail balls 1 inch in diameter, and a downpour of rain that flooded many sections of the area. It was reported that over 6 inches of rain fell in less then 4 hours. The storm appeared to be most intense in the foothill area, where Penrose Stadium is located. The group of volunteers from ITS keeping watch over night on the equipment at the stadium, had attempted to cover the equipment with plastic sheeting. This effort was wasted; all the equipment was covered in red-clay mud and was thoroughly soaked. Standing water up to six inches deep turned the earthen floor of the stadium into a small lake. The storm cleared by about 6:30 p.m., and a close inspection of the equipment resulted in the decision to cancel what was billed as "The All American Electrical Show", which was to have started at 8 p.m. that evening. As it turned out, a second storm came over the area later that night, dumping an additional three inches or so of rain. Long term residents of the area referred to this event as "the fifty year storm".

IT'S NOT NICE TO FOOL MOTHER NATURE.

Sunday morning, July 23, the weather was again clear and mild. Further inspection of the equipment at the stadium was impossible; even the forklift with its large pneumatic tractor-type tires could not maneuver, even at the end of the day. It would be two more days of mild weather before the earthen floor of the stadium dried out enough to move the machinery and equipment. One week later, the [damaged] equipment that comprised Model 13M, arrived via a flat bed tractor-trailer rig, back in Southern Califirnia. From there, the equipment was placed in storage for 12 months, until July 3, 1995.

LESSONS LEARNED (TAKE THREE).

As in any scale Tesla coil system, it is imperative to limit the number of unknown characteristics or variables during development and testing. Ideally, only one parameter is adjusted at a time, noting the results and moving on until all the variables are optimized. This is particularly possible where there is sufficient control over the environment and sufficient time to carry out the development process. On this basis, after the winter rainy season was concluded in Southern California, the Model 13M Magnifier was [again] set up at the broadcast a.m. transmitter site, beginning July 3, 1995 and ending in late November. The weather at this location allowed the possibilty of having the entire system set up outdoors with minimum risk of weather damage.

The a.c. power mains supplied to the transmitter site is 480 volt 60 Hz, 3 phase. Each leg is rated at 300 amps continuous load at this voltage. A new stepdown transformer rated at 480/240 volt and 150 KVa was used to supply power to the 2-bay rack cabinet controller for 13M. A seperate safety lockout disconnect switch from the mains buss and a 300 amp 480 volt breaker switch insured adequate personnel safety. A comprehensive testing and development program for the Model 13M Magnifier Tesla Coil was now possible.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The first order of business was to redesign and construct the rotary gap, to handle 100 KVa a.c. power input, without overheating. The idea of using pressurized nitrogen gas to reduce the gap dwell time and quench the arc, was abandoned. In its place, a dual chamber squrrel cage blower directed air into a combined plenum box and then force-fed air into the bottom of the rotary gap enclosure. Care was taken in insuring the direction of air flow matched the rotational direction of the rotary arms. The rotary arms were redesigned with different electrode angles, and the new thoriated tungsten electrodes were electrical discharge machined (EDM) for cross-drilled press fit wrist pins, to insure positive locking of these electrodes in the ends of the rotary arms. The stationary electrode holders were modified to include large surface area aluminum heat sinks for cooling. The tungsten electrodes used in these holders were diamond ground for captive flats on their sides, to insure positive locking with set screws. The phenolic sheets that supported the stationary electrode assemblies were replaced with G-10 epoxy-fiberglass plates. These plates have a considerably higher temperature immunity and physical strength, compared to phenolic.

The origional capacitor bank consisting of a 0.16 MFD 50 KV AC RMS unit was still employed when the third test operations began on July 5, 1995. This group was eventually replaced with a second group of surplus capacitors, that were arranged in series parallel, for a combined total capacity of 0.29 MFD. Each capacitor was rated at 0.22 MFD and 50 KVDC. Three capacitors were series connected for a string capacity of 0.073 MFD. at 150 KVDC rating. Up to four strings could be parallel connected. With three strings in parallel, the combined rating was 0.22 MFD at 150 KVDC. These capacitors utilize poly-propylene film as the dielectric. The Extra Coil output discharge length improved with this set of capacitors, compared to the origional group, however it was felt that a polypropylene capacitor bank made of new units specifically built for pulsed r.f. oscillator circuit service, would yeild the best possible results. Ten new capacitors, each rated at 0.1 MFD and 50 KV pulse, were ordered and series-parallel connected for a combined total capacity of 0.25 MFD at 100 KV pulse. The new capacitors proved to be the most efficient on an input KVa vs. discharge length basis. Throughout this testing session, the following capacities were experimented with: 0.16, 0.21, 0.22, 0.29, 0.25, and lastly, 0.275 MFD. The latter proved to be the optimum capacity for the primary resonant tank circuit. In addition to varying the capacitance value, the primary inductance was changed from two single parallel connected turns to a single two-turn configuration. The spacing was adjusted between the primary winding and the secondary from a radius of 12.0 inches to 10.0 inches. At this spacing, the rotary gap dwell time was deemed too long in duration at 25 micro-seconds, and was reset at 12.0 inch radius. Additional turns were added to the base of the secondary coil, which resulted in extreme D'Arsonval discharge breakdowns between adjacent turns. These were so distructive as to melt and sever portions of the #4 AWG wire. After extensive and systematic changes were exhausted, the origional Master Oscillator specification was restored, and run with the finalized capacity of 0.275 MFD.

At this point, the Extra Coil was capable of delivering discharges from about 40 to in some cases, over 55 feet in length. Calculations based on the actual input power, the voltage under load supplied to the capacitor bank, the total series inductance value of secondary, transmission line and extra coil, the total capacitance of these, and the repetition rate of the rotary gap, show an output discharge rate of 39 arcs/second at 40 feet in length. The calculated energy of each spark is 0.833 KW, which is 32.4 KW/second.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

It must be borne in mind that the location of this test site is a major Los Angeles market A.M. transmitter and antenna farm location. The Model 13M Magnifier system was physically located in the near-field radiation pattern of the transmitter antenna farm. The five tower 3/8 lambda phased array antenna system provides over 8 dBi gain, so that even at reduced power for night time transmission (20 KW input), actual inductance or capacitance measurements on the Model 13M Magnifier system were not possible. However, frequency and time domain measurements were conducted during the operational sessions of testing this Tesla magnifier. Specifically, for frequency domain measurements, an HP-8563A spectrum analyzer and an HP-3561A dynamic signal analyzer were used to measure power spectral density (PSD). Time domain measurements were carried out with a Tektronix 468 digital storage oscilloscope. Calibrated antenna probes were used for all measurements except in the case of the Tek-468, which used a simple "gimmic" vertical wire probe. The plotted results of the HP-3561A and the Tek-468 are shown at the end of this paper. The HP-3561A graphs show the spectral content of 13M to be fairly broad in frequency, with two distinctive peaks at approximately 75 KHz and 87 KHz. The shifts shown in the four graphs reproduced, reflect changes in tuning due to varying the primary tank capacitance. The final graph labeled "last run 9:40 p.m." represent 0.275 MFD tank capacity, and agrees well with the HP-8563A result in photo #4. The illustrations in photos #1-3 are taken from the Tek-468 storage scope. Photo #1 specs: vertical input attn.= max. variable @ 50 volt/division and a horizontal sweep rate of 5 us./divison. Photo #2 specs: vertical input same as photo #1 and horizontal sweep 2 us./division. Photo #3 as above, with 20 us./division. Analysis of photo #1 shows the rotary gap commutating over a 20 us. period, followed by primary coil ring time out to 50 us. Photo #2 shows an expanded horizontal scale to reveal more detail in the rotary gap multiple firing process reproduced at 2 us./horizontal division. Photo #3 at 20 us./ horizontal division, shows the Master Oscillator primary coil ring, followed by the first oscillatory wave train responce of the secondary coil. All of the above measurements were conducted on August 19, 1995, and were taken using the second set of surplus capacitors. No measurements were made using the new third set of capcitors, which is unfortunate, as the latter clearly proved to be superior in performance. Following the last series of demonstrations and tests at the end of November 1995, the entire system was dismantled and placed in storage, and has remained as such, to this date.

FUTURE PLANS AND FURTHER MODIFICATIONS.

Another test session is planned for the latter part of 1996. At this time, it is not clear if the location will be the same as the first and third test sessions. In any case, the following is a list of planned improvements and modifications, that may result in this system's performance with arc lengths approching 60-75 feet in length.

1) Raise the Extra Coil elevation above ground from the present 76 inches to 108 inches by the addition of a third porcelain pedestal insulator to each of the four supports. This will aid in decoupling the coil from the ground plane and raise the height above ground of the transmission line, which will reduce the number of D'Arsonval discharges from this line to ground.

2) Add more electrostatic capacity to the existing 8 foot diameter toroid discharge electode. This will be accomplished by the inclusion of a 24 inch diameter aluminum sphere, placed above the center of the top of the toroid, with approximately 36 inches spacing. It seems clear that the 8 foot diameter toroid alone is not the optimum capacity for the Extra Coil to load into. However, it was the largest size that could be ordered. By adding the sphere, and placing it properly above the toroid, the Faraday effect between the two bodies will effectivly increase the surface area and therefore total capacity.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

3) Design and construct a sulpher hexifloride (SF6) pressurized gap, to be series connected to the existing rotary gap. This will allow an adjustable commutation time from about 25 us. down to less then 15 us. It will also allow higher capacitor charging voltages before gap firing, increasing the energy per pulse that is delivered to the Master Oscillator.

4) Increase the KVa capacity of the 2-bay rack cabinet power supply controller, from its current maximum capacity of 100 KVa to 150 KVa. This will be accomplished by the addition of three more autotransformers to the voltage control and current control stacks, raising the total from 12 to 18 units. This will be necessary in order to take full advantage of the higher energy operating capability afforded by the addition of the series SF6 pressurized gap.

5) Select a new test site for the fourth testing session that is in a low r.f. environment, to afford a real opportunity to conduct accurate test measurements of both system capacitance and inductance. This can only be done in a quiet ambient r.f. radiation location.

6) One of the most provocative research objectives, that was part of the origional imputus for constructing this project, was the idea of using such an apparatus to initiate triggered lightning. With the equipment predisposed in a good location under a densely charged cloud formation, this author believes that this equipment will pose as a viable alternative to the use of small rockets with trailing wires. This attempt may also aid in initiating natural ball lightning phenomena.

CREDITS.

The construction of the Model 13M Magnifier Tesla Coil system was and continues to be, a team effort. Many individuals contributed their time and talent to produce the results achieved to date. Acknowledgement of the members of this team is appropriate. The financial partners mentioned in the beginning of this paper are a consortium of individuals from Rosen's Electrical Equipment Company Incorporated, of Pico Rivera, California. Virtually all of the components and materials used to construct 13M were supplied by or through this company. It is through their continuing support, that this project has a future. Other people who are due a great deal of credit are: Lee Roan-W6GQE, who served as shop foreman, master craftsman, and contributed greatly to the final physical design of the Master Oscillator and Extra Coil framework. Scot Barth-KA6UDZ, Steve Harris-KD6LAJ, Tony Chillemi-KD6IFC, Rosalee Sorrell-KD6KSG, and Frank Decker, all of whom traveled to Colorado Springs in July, 1994, in addition to helping build and test 13M in Southern California. Matt Mendenhall-KE6ALM, Dave Qualls-K6AYK, Rick Barrett-KE6DKF, Scott Booth-KC6TTR, David Ping-KK6GH and Richard Silvera-KC6YQD (the chief and assistant chief engineers of Greater Los Angeles Radio-KRLA). Jim Hardesty-N2DRT, who has always helped at Colorado Springs. Don Teep, James T. Shaffer, for machine work on the rotary gap, Martin Bottjer, Dr. James F. Corum, and Dr. Robert B. Dybdal, and perhaps most importantly, Brad Norman, who has always helped with each ITS symposium (and almost single-handedly saved Model 13M from being lost in the mud at Penrose Stadium.)

Company acknowledgement is made to The O. W. Landergren Company, for providing the 8 foot diameter toroid, Hipotronics Incorporated, for providing the polypropylene capacitors, Greater Los Angeles Radio, Incorporated, for providing the test site in Southern California, and The International Tesla Society, Incorporated, for providing the opportunity to exhibit Model 13M in Colorado Springs, 1994.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

REFERENCES.

1) Kotter, R.F., Smith, A.N., "A Study of Air-Gap Breakdown at 28.5 Kilohertz." IEEE Trans. PAS Vol. PAS-102, No.6 (1983) 1913.

2) Corum, J.F., Corum, K.L., "A Technical Analysis of the Extra Coil as a Slow Wave Helical Resonator." Proceedings of the 1986 International Tesla Symposium, International Tesla Society, Inc., 1986, PP. 2-1 to 2-24.

3) Corum, J.F., Corum, K.L., "Tesla Coils-An RF Power Processing Tutorial For Engineers." Proceedings of the 1988 International Tesla Symposium, International Tesla Society, Inc., 1988, PP. 2-8 to 2-48.

4) Anderson, L.I., "Nikola Tesla On His Work With Alternating Currents and Their Application to Wireless Telegraphy, Telephony, and Transmission of Power." Sun Publishing, Denver Colorado, 1992, PP. 48-179, Appendix II, PP. 169-179.

5) Wysock, W.C., "Modern Spark Gap Technology." Proceedings of the Extraordinary Science Symposium 1991, International Tesla Society, Inc., 1991.

ILLUSTRATIONS.

1) Model 14M Magnifier System, side view.
2) Model 14M Magnifier Primary and Secondary Coil Support Frame, plan view.
3) Model 14M Magnifier Primary and Secondary Coil Form, plan view.
4) Model 14M Secondary Coil Outer-most Helix Bobin Support, side view.
5) Model 14M Secondary Coil: 1st Secondary Winding, side view.
6) Model 14M Extra Coil Detail, side view.
7) Model 13M Magnifier System, side view.
8) Model 13M Magnifier Primary and Secondary Coil Assembly, side view.
9) Model 13M Magnifier Primary and Secondary Coil Form, bottom view
10) Model 13M Magnifier Primary and Secondary Coil Form, side view.
11) Model 13M Extra Coil Assembly, side view.
12) Model 13M Extra Coil Detail, side view.
13) Model 13M Secondary and Extra Coil Detail, side view.
14) Model 13M Schematic.
15) Model 13M Comparison notes vs.Colorado Springs Notes (CSN)
16) Model 13M Calculations.
17) Model 13M Power Spectral Density (PSD), HP-3561A Dynamic Signal Analyzer.
18) Model 13M Frequency Domain Measurements, HP-8563A Spectrum Analuzer.
19) Model 13M Time Domaim Measurements, Tek-468 Digital Storage Oscilloscope.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER TESLA COIL

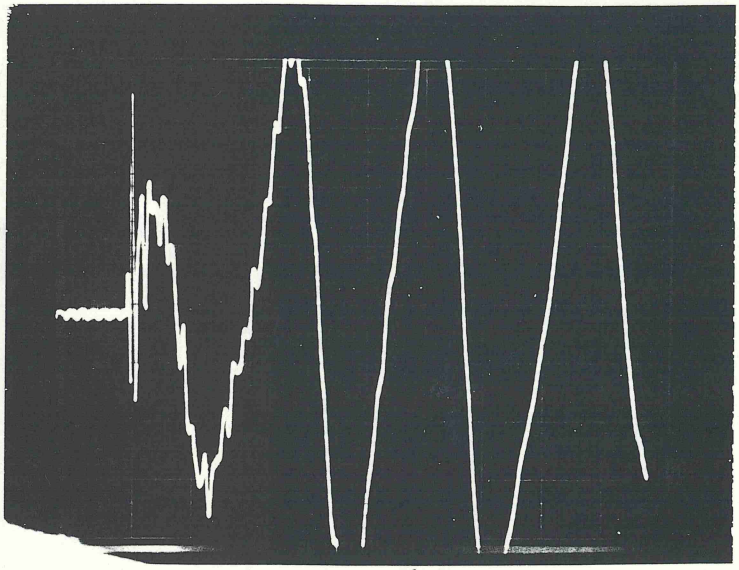


PHOTO 1

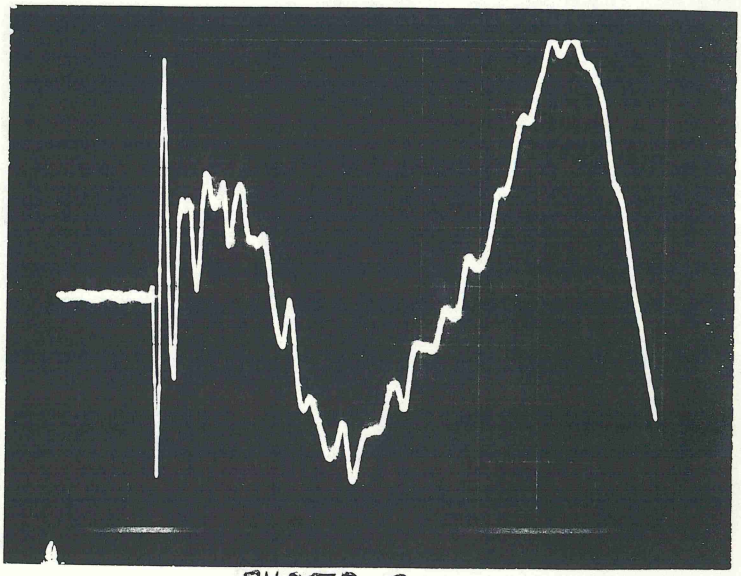


PHOTO 2

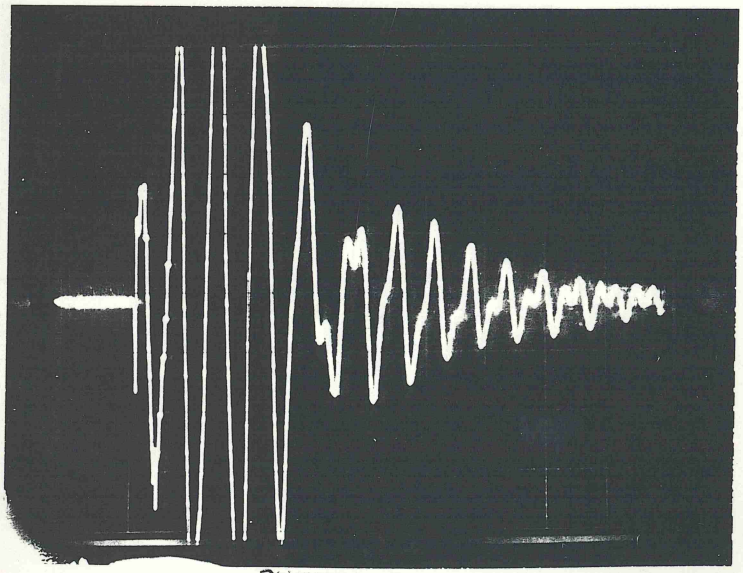
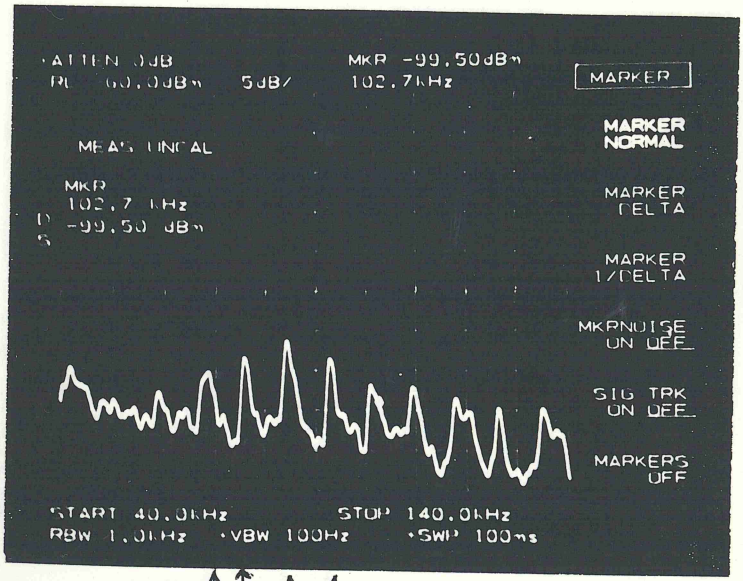


PHOTO 3



70KHZ ↑ 75 ↑ 84 ↑ 92 KHZ PHOTO 4

8-19-25

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER TESLA COIL

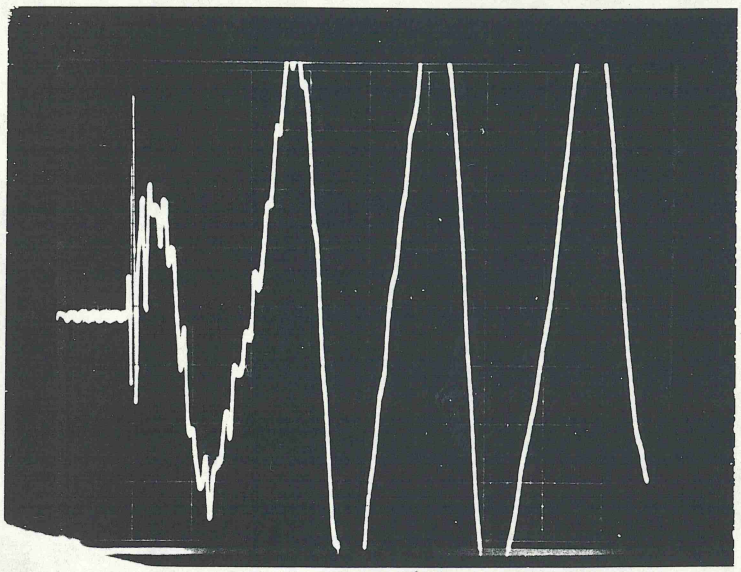


PHOTO 1

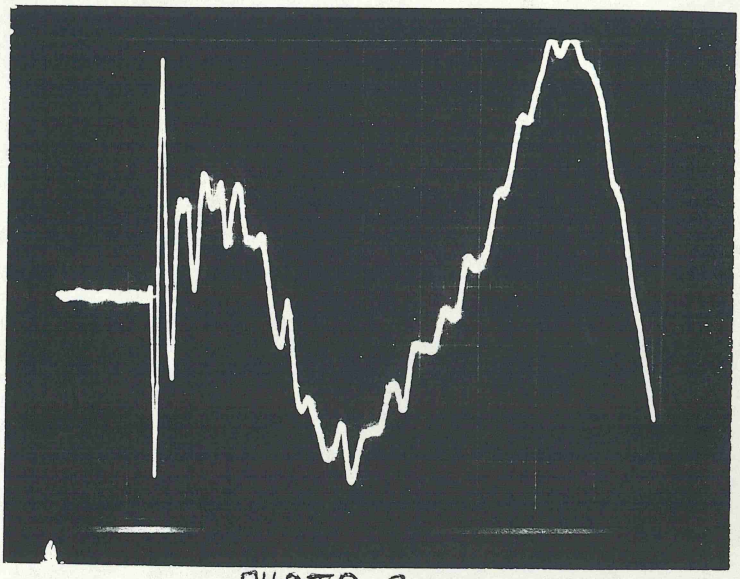


PHOTO 2

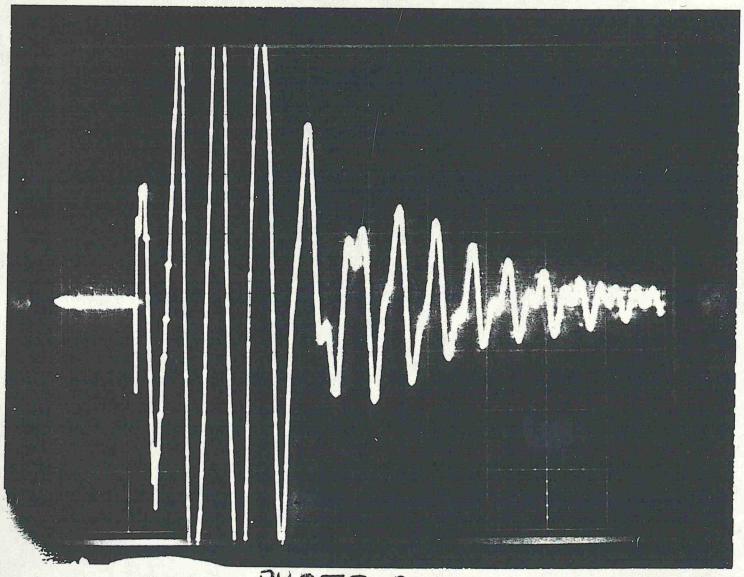
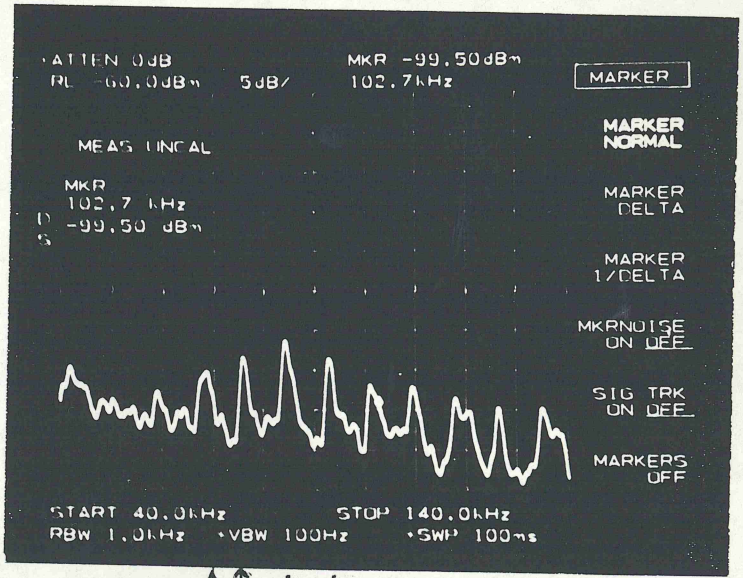


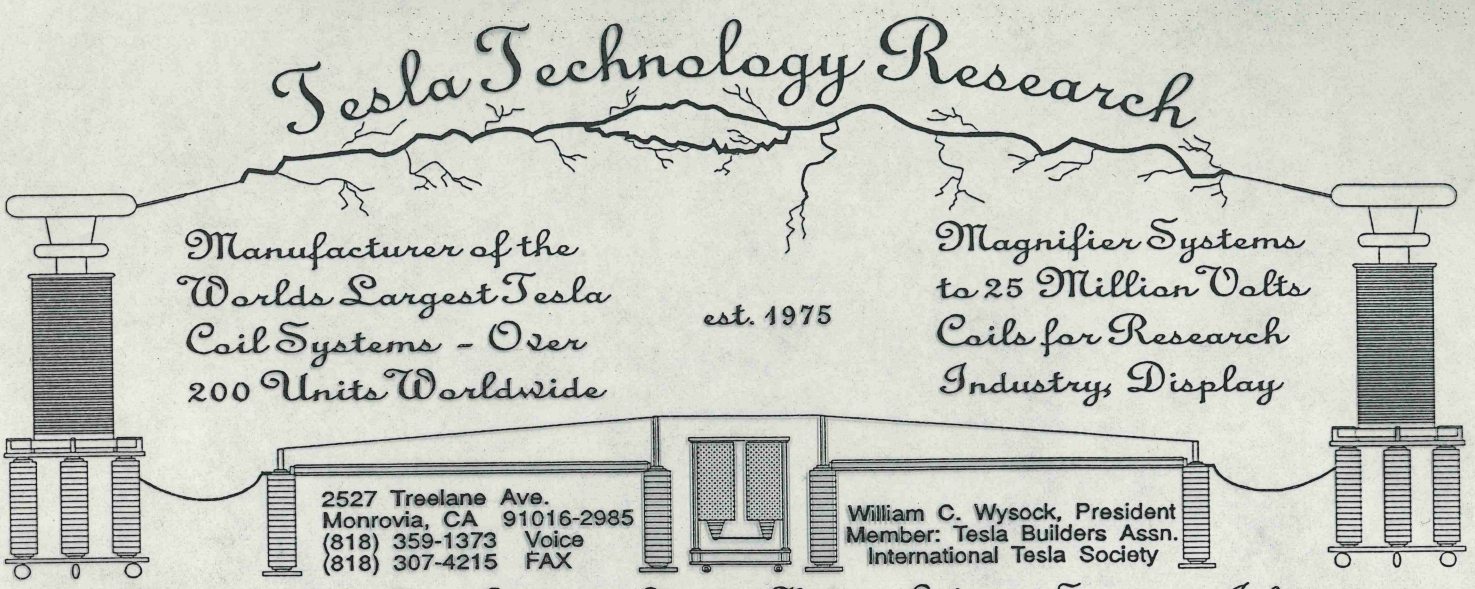
PHOTO 3



70KHZ ↑ 75 ↑ 84 ↑ 92 KHZ PHOTO 4

8-19-25

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



MODEL 14 MAGNIFIER TESLA COIL SYSTEM PROSPECTUS

I. PROJECT DEFINITION.

II. PROJECT OBJECTIVES.

III. PROJECT APPLICATIONS.

IV. PROJECT ITINERARY.

V. PROJECT MATERIAL REQUIREMENTS.

VI. ESTIMATED MATERIAL COST.

VII. ESTIMATED LABOR COST.

VIII. PROJECT FUNDING RESPONSIBILITY.

IX. RETURNS ON INVESTMENTS.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. Wysock-N6UXW
Tesla Technology Research
747 Crescent Drive
Monrovia, CA 91016-1534
(818) 359-1373

DESIGN, CONSTRUCTION AND TESTING OF A LARGE SCALE MAGNIFIER-TYPE TESLA COIL SYSTEM

"I actually used in all these three forms, almost every day, all these devices; and furthermore, I had other methods which are not yet patented, and those are corking fine methods." N. Tesla. [4]

1.) INTRODUCTION AND BACKGROUND.

In January 1994, the design for a scaled version of Tesla's famous 1899 Colorado Springs magnifier coil was conceived. The goals were to use modern construction techniques and materials as an integral part of the overall coil design, seek financial sponsorship to assist in funding the projcet, and finally, build and test the system in time for exhibition at the 1994 International Tesla Symposium. The origional design for the Master Oscillator, (Tesla primary and secondary coils), was to be a multi-layerd archimedian flat spiral that would be 20 feet in diameter. The framework supporting these two coils was to be made of fiberglass and form a framework that could be bolted together on location, and would elevate the horizontal plane of the primary and secondary coils 20 feet high above ground. The electrical and physical advantages of this design over Tesla's 49.25 foot diameter helical-wound primary and secondary coils as used in 1899, are well known. Even Tesla had previous practical experience with this form of r.f. transformer winding technique, as witnessed from photographs in his Houston Street laboratory prior to the Colorado Springs development work, and again at Wardenclyffe; Tesla used flat spiral transformer designs. These advantages are the ability to control the voltage gradient distribution along the secondary winding, and an improved coupling coefficient between the primary and secondary, where the primary is wound about the circumference of the outer diameter of the secondary coil, which is the ground point of the secondary. This places the largest amount of secondary coil inductance in a closer magnetically coupled influence of the primary winding, thereby increasing mutual coupling between the two windings, producing higher energy transfer efficiency.

In a high frequency, high voltage transformer, E-field or voltage gradient control becomes a serious concern. Corona losses need to be eliminated or minimized in order to to achieve maximum transformer efficiency. In a flat spiral secondary construction where the low voltage or ground point is at the periphery, the high voltage point will be at the center of the spiral. The electromagnetic fields set up in this type of winding produce a Faraday shielding effect on successive turns, reducing stray corona leakage. In Tesla's early development work, this form of control was experimented with, as well as other methods, such as enclosing the entire transformer in oil. It is interesting to note that the modern-day automotive ignition coil (for which Tesla received a patient,) combined the attributes of a primary winding around concentric layers of secondary windings, the high voltage end of which is at the center of the winding, and is electrically connected to a silicon steel laminated core. This core material increases the permeability of both windings and, along with the whole assembly being contained in oil, provides a design of smallest size and highest efficiency.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

In a Tesla transformer of much higher input power and size, it becomes impractical to employ oil or any ferrous core material. However,the fore-mentioned coupling efficiency of the concentric layer approch with the high voltage end at the center of the construction, becomes a very attractive design feature. The origional design for a scale version of the 1899 project using this principle was presented to prospective financiers in February, 1994. It was deemed too expensive and physically large to handle, within the time and budgetary constraints that were imposed. Thus, Model 14M, as this design was dubbed, had to be shelved. In its place, an even smaller design Master Oscillator was substituted of much the same construction as Tesla utilized in 1899. This second design would be 1/5 scale in size and amount of inductance in the primary and secondary windings, as compaired to Colorado Springs. The secondary winding would therefore be a single layer helical winding on an open framework. Wood was substituted in this new design instead of fiberglass, in order to further reduce anticipated construction costs. Of all the available types of wood, Sitka spruce was the most desirable (and expensive!) This is the same type wood that large power transformer manufacturers utilize as coil supports in their construction. This wood comes only from Alaska and sells for about $3.00 per linear foot. The physical and electrical attributes of this type of wood are that it is a straight-grained closed-cell growth dense wood, and when properly kiln dried and varnished, makes an excellent insulation support material that is easily machinable, with a low dielectric loss tangent, even at moderately high frequencies and very high voltages. More then $4,000.00 of this material was procured for use as the Master Oscillator upright supports, and the squirrel cage structure for the tertiary or Extra coil form. The lower support framework supporting each coil structure was made from clear Douglas fir and pine wood.

The 1/5 scale version Master Oscillator design was to employ a moderately high degree of mutual coupling between the primary and secondary windings, due to close physical spacing, and decoupling both windings from excessive loading against the ground plane, by physically elevating both windings. The high value of M (mutual coupling), implied a need for a very short dwell or commutation time of the rotary spark gap, or "rotary break," as Tesla referred to in his Colorado Springs diary notes. The commutation time that was determined as optimal, was on the order of 15 microseconds. Designing and building a rotary gap to handle very high levels of input power and voltage, yet provide very short pulse durations, proved to be sizable design challenges.

The inital concept for the rotary gap centered on the use of a salient-pole syncronous motor. The origional planned A.C. power input level was to be on the order of 50 KW, with a tank circuit charging voltage up to 60 KV. In order to handle high power and voltage levels, yet produce very short commutation dwell times, the physical size of the spark gap was dictated by the rotating velocity required of the rotary electrodes. These electrodes were configured as dual pairs of 0.50 inch diameter thoriated tungsten round rods with hemi-sperical ends, mounted in the ends of a pair of aluminum rotating arms on a common dirveshaft. The stationary electrodes were also dual pairs of the same construction, placed 90 degrees apart at fixed locations around the rotary arms. The geometry of the electrodes with their hemispherical ends and a design speed of 3,600 r.p.m. on the driveshaft, determined the radius of rotation needed to achieve a mechanical dwell duration that approched the origional design goal of 15 microseconds. This design had to be compromised somewhat, due to the cost of materials and manufacturing, and practical limitations of available torque from the drive motor, to turn the driveshaft and rotary arms at a speed of 3,600 r.p.m.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Two design apporches to couple power from the motor shaft to the driveshaft were considered; direct-coupled insulated shafting and positive drive belting on electrically and mechanically decoupled shafts. The latter was chosen for the advantages of reduced size and fewer mechanical design problems. A flat positive drive timing belt with a 10 horsepower at 3,600 r.p.m. rating was obtained and phenolic positive drive pulleys for both the motor and rotary arm shafts were fabricated, as well as a phenolic idler pulley to take up torque induced slack on the return side of the belt. This belt exhibits sufficient electrical insulation qualities such that the leakage current to ground from the rotary arm driveshaft is limited to about 3.5 milliamps with 50 KV on the rotary arm driveshaft.

The rotary arms were sized to rotate about a 24 inch diameter circle, circumscribed by the hemispherical tips of the tungsten rotary electodes. This arrangment limits the spark dwell time from the rotary electrodes to each group of stationary electrodes to the order of 25 microseconds at 3,600 r.p.m. To further reduce spark dwell time, the enclosure housing of the rotary gap was designed to be pressurized with nitrogen gas up to 30 p.s.i. One inch thick clear plexiglas sheeting was chosen for the enclosure material, which offered the advantages of ease in machining, mechanical strength, and the ability to visually observe the performance of the gap while energized.

The origional design capacity for the resonant tank circuit consisting of a capacitor bank, rotary break, and Master Oscillator primary inductance was 0.16 MFD at 50 KVAC-RMS, from four Cornell-Dublier phenolic case pulse units that were obtained surplus. It was not known what dielectric material was used in these units; i.e., mica, mylar or other type of plastic film. The ESR (equivilent series resistance), was measured and the dissapation factor of each unit was rated at 0.36. Additional capacitors were made available to allow for testing with different values of primary tank capacity.

The Master Oscillator primary inductance is constructed from two parallel-connected single turn coils of 500 MCM welding cable, and placed about the periphery of the Sitka spruce upright supports, that form the framework for the secondary coil. The primary coil is 12 feet in diameter, and the center-to-center spacing of the two single turns is set at 4.5 inches. This same type cable is used exclusively for all inter-connect wiring, along with 4 inch wide copper straping for the capacitor bank. The coil form made of Sitka spruce, is supported on a framework of clear Douglas fir framing, elevated 4 feet above ground on 4 porcelain pedistal type insulators. The radius between the vertical centerline of the primary and secondary windings is set at 12 inches. However, provision is made for reducing this distance. The vertical offset between the horizontal centerline of the primary to the first turn of the secondary winding is set at 2 inches, and is also designed for adjustment. The secondary winding consists of 30 turns of mil-spec #4 AWG stranded insulated cable with a 105 degree C heat rating. These turns are spaced 1.8 inches apart, and the diameter of this helical winding on its Sitka spruce squirrel cage form set at 10 feet. The final top turn is connected to a toroid capacity terminal ring 10 feet, 8 inches in diameter, with a cross section of 4 inches. This ring is fabricated from smooth outside wall, light galvanized flexible steel tubing. The toroid ring serves two purposes; to provide an electrostatic capacitive load to the output of the secondary winding and to eliminate the possibility of corona streamer leakage. The transmission line or interconnecting link between the output of the secondary winding to the input of the Extra Coil, is also made of this material. The transmission line is 45 feet in length, the distance between the facing sides of the two coil assemblies. The design of the Master Oscillator coil has proven most effective and satisfactory in all operations.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The Extra Coil which is treated as a self-resonant inductance, utilizes the same construction and materials as in the Master Oscillator. The helical coil form is fabricated from Sitka spruce and three 5 foot diameter fiberglass flat discs. The coil form is 5 feet in diameter and 10 feet in length. 150 turns of #8 AWG mil-spec insulated stranded cable are wound with a spacing of 0.8 inches per turn. 4 inch diameter flexible steel tubing form corona supression toroid rings and are used as both the first and last turn of the inductance on this coil. A phenolic tube spacer 3 feet in height and 2 feet in diameter is used to support the main toroid discharge terminal. This terminal is hollow spun aluminum, 8 feet in diameter and 30 inches in cross-section. The Extra Coil is supported on a douglas fir wood framework and mounted on a porcelain insulator stand 6 feet 4 inches in height. The overall height of the Extra Coil assembly is 20 feet 4 inches or 6.2 meters.

The origional high voltage power supply transformer was nameplate rated as a 25 KVa unit, with tap positions on the low voltage winding corresponding to an output voltage up to 60 KV. The construction of this unit was thought to be conservatively built such that for short periods of operation, its KVa rating could be increased two fold, to 50 KVa. In the origional testing of this system at Southern California, it was discovered that indeed the core of this transformer went into complete saturation above the 25 KVa level. Therefore, all of the first (alpha) tests conducted on this system were limited to a maximum a.c. input of 25 KVa. These tests took place between July 16-18, 1994. Due to the shortness of available time, the initial proof-of-performance testing was all that could be accomplished, prior to loading the entire system into a 51 foot long 10 foot high container, for transport to Colorado Springs.

The equipment arrived at Colorado Springs at 9 p.m. on July 20, 1994. The intended exhibit site was to be an outdoor equestrian area known as Penrose Stadium. Setup of the equipment commenced at 7 a.m. on July 21, and the date for exhibit was set as Saturday, July 22. A seperate power supply transformer was ordered from a firm in Arkansas, and was scheduled for arrival on July 20 at the exhibit location. This second transformer is a 100KVa unit that stands 8 feet high, weighs approximately 2,500 pounds, and is rated for 240/480 low voltage and 36 KV high voltage. To energize this unit, the ITS planning committee arranged to have a 138 KVa stepdown transformer on location, to connect the stadium's mains at 480 volt down to 240 volt, which is the required input voltage for the custom made 2-bay rack cabinet power supply controller. The physical setup of the Model 13M system requires a work crew of 6, a fork lift, a bucket truck, and a crane. It requires approximately 8 hours, simply to accomplish the physical construction of this equipment. In a large apparatus such as 13M, electrical characteristics and tuning are always widely influenced by the surrounding immediate invironment. The reflectivity and conductivity of Colorado's red clay-like earth behaves very differently as compared to the asphalt surface of the (alpha) test site in Southern California and represented significant tuning changes. Perhaps most importantly, the integrity of a master ground reference for the input of the Master Oscillator's secondary coil, was questionable. At the (alpha) test site, the location of a 50KW A.M. radio transmitter installation, with its vast ground point and radial counterpoise system feeding a 5 tower phased array, was available for a master ground reference. At Penrose Stadium, only a series of galvanized steel posts as perimiter fencing was accessable. No ground resistivity tests were possible at either location, due to the short amount of time available. At Penrose, all the equipment was set up on sheets of 3/4 inch thick, 4 foot by 8 foot plywood, which lay upon the dirt surface of the stadium floor.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MURPHY'S LAW AND OTHER ANOMALIES.

The equipment setup started the morning of July 21 at Penrose Stadium. NOAA weather servies as well as the Air Force base weather data forecast mild temperatures and light wind conditions. All of the equipment was [finally] ready for initial power-up testing as of 11 p.m. The night sky was clear and the temperature had dropped into the low 70's. The rotary gap motor which is slowly raised from 0 up to the running speed of 3,600 r.p.m. by means of a 15 KVa autotransformer, was energized. As the rotary gap approched about 1,800 r.p.m., there was a sudden violent vibration observed, and the emergency E-stop control was activated. A close inspection of the gap showed that the 10 h.p. motor was loose on its mounting bolts, causing the positive drive belt to skip as the motor was physically raised up off its mounts by the increase in torque. This in turn, caused the thoriated tungsten rotary electrodes to come in distructive contact with the stationary electrodes, shattering six of these $200.00 rods. In an emergency attempt to salvage what was left, the plexiglass housing had to be field-stripped, the sheared-off electodes removed, the rotary arms re-balanced with only single electrodes in their two ends, the debris removed from the interior of the 1 inch thick enclosure, and then reassembled. At about 2 a.m. on Saturday July 22, the system was finally ready to be tested.

Several important changes were incorporated in this [beta] test; 1) The origional 25 KVa transformer was now replaced by a 100 KVa unit. 2) The mains source could supply up to 138 KVa, instead of only 50 KVa, the limit at the [alpha] test site. 3) For the first time, the use of nitrogen gas to reduce spark gap dwell time, by pressurizing the rotary gap enclosure up to 15 p.s.i., was included. As the system was powered up [successfully] for the first time and slowly raised to about 80 KVa input, long streamer discharges were observed emanating from the 8 foot diameter toroid discharge terminal. These appeared to approximately 25-30 feet in length. Also observed were several heavy [D'Arsonval] type discharges about 8 feet in length, going from the trans-mission line to ground, at a point approximately 15 feet before the input to the Extra Coil. This was the same type phenomena shown in photographs of Tesla's 1899 machinery. This power-up test lasted for about one minute. The system was then powered down and the equipment inspected. The rotary spark gap enclosure exhibited a dark orange-yellow color to its interior; the result of the nitrogen gas recombining into nitric oxide. As the work crew approched the location of the spark gap for a closer look, the plexiglass enclosure began to develop a large quantity of heat stress cracks at most of the 3/8-16 threaded bolt centers; the result of intense temperature difference between the interior and exterior of the enclosure. It was estimated that the interior temperature had raised over the one minutes' operation at the 80 KW level, from ambient to above 400 degrees F. This observation was validated by virtue of the fact that the phenolic plates that locate the stationary electrode assemblies around the rotary arms, were bubbled on their surfaces and exhibited resin seepage. This observed condition had not been previously encountered at the [alpha] test site undoubtedly because of the significantly lower input power level. Since the system appeared to be usable, in spite of the setbacks encountered, it was decided to stop work for the night and make additional repairs to the rotary gap later in the morning. Several members of the ITS staff volunteered to keep watch over the equipment for the remainder of the night.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THE "FIFTY YEAR STORM" AT PENROSE STADIUM.

At 9 a.m. July 22, a local machine shop was contacted to provide six centerless ground 0.5 inch diameter replacement electrodes with hemispherical ends. These were only available in tungsten-carbide instead of thoriated tungsten. The top plexiglass enclosure plate had been removed and machined so that three venting holes could be bored, to increase hot air exhausting from the gap enclosure interior. As the work progressed, the skies over Colorado Springs became overcast and it began to sprinkle. A check with the weather services indicated a "slight" low pressure front was moving through the area and the updated forecast was for clearing by afternoon. As the noon hour approached however, this "slight" weather front had intensified and became a catagory 1 force storm with gail winds sustained above 70 m.p.h., intense lightning, hail balls 1 inch in diameter, and a downpour of rain that flooded many sections of the area. It was reported that over 6 inches of rain fell in less then 4 hours. The storm appeared to be most intense in the foothill area, where Penrose Stadium is located. The group of volunteers from ITS keeping watch over night on the equipment at the stadium, had attempted to cover the equipment with plastic sheeting. This effort was wasted; all the equipment was covered in red-clay mud and was thoroughly soaked. Standing water up to six inches deep turned the earthen floor of the stadium into a small lake. The storm cleared by about 6:30 p.m., and a close inspection of the equipment resulted in the decision to cancel what was billed as "The All American Electrical Show", which was to have started at 8 p.m. that evening. As it turned out, a second storm came over the area later that night, dumping an additional three inches or so of rain. Long term residents of the area referred to this event as "the fifty year storm".

IT'S NOT NICE TO FOOL MOTHER NATURE.

Sunday morning, July 23, the weather was again clear and mild. Further inspection of the equipment at the stadium was impossible; even the forklift with its large pneumatic tractor-type tires could not maneuver, even at the end of the day. It would be two more days of mild weather before the earthen floor of the stadium dried out enough to move the machinery and equipment. One week later, the [damaged] equipment that comprised Model 13M, arrived via a flat bed tractor-trailer rig, back in Southern Califirnia. From there, the equipment was placed in storage for 12 months, until July 3, 1995.

LESSONS LEARNED (TAKE THREE).

As in any scale Tesla coil system, it is imperative to limit the number of unknown characteristics or variables during development and testing. Ideally, only one parameter is adjusted at a time, noting the results and moving on until all the variables are optimized. This is particularly possible where there is sufficient control over the environment and sufficient time to carry out the development process. On this basis, after the winter rainy season was concluded in Southern California, the Model 13M Magnifier was [again] set up at the broadcast a.m. transmitter site, beginning July 3, 1995 and ending in late November. The weather at this location allowed the possibilty of having the entire system set up outdoors with minimum risk of weather damage.

The a.c. power mains supplied to the transmitter site is 480 volt 60 Hz, 3 phase. Each leg is rated at 300 amps continuous load at this voltage. A new stepdown transformer rated at 480/240 volt and 150 KVa was used to supply power to the 2-bay rack cabinet controller for 13M. A seperate safety lockout disconnect switch from the mains buss and a 300 amp 480 volt breaker switch insured adequate personnel safety. A comprehensive testing and development program for the Model 13M Magnifier Tesla Coil was now possible.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The first order of business was to redesign and construct the rotary gap, to handle 100 KVa a.c. power input, without overheating. The idea of using pressurized nitrogen gas to reduce the gap dwell time and quench the arc, was abandoned. In its place, a dual chamber squirrel cage blower directed air into a combined plenum box and then force-fed air into the bottom of the rotary gap enclosure. Care was taken in insuring the direction of air flow matched the rotational direction of the rotary arms. The rotary arms were redesigned with different electrode angles, and the new thoriated tungsten electrodes were electrical discharge machined (EDM) for cross-drilled press fit wrist pins, to insure positive locking of these electrodes in the ends of the rotary arms. The stationary electrode holders were modified to include large surface area aluminum heat sinks for cooling. The tungsten electrodes used in these holders were diamond ground for captive flats on their sides, to insure positive locking with set screws. The phenolic sheets that supported the stationary electrode assemblies were replaced with G-10 epoxy-fiberglass plates. These plates have a considerably higher temperature immunity and physical strength, compared to phenolic.

The origional capacitor bank consisting of a 0.16 MFD 50 KV AC RMS unit was still employed when the third test operations began on July 5, 1995. This group was eventually replaced with a second group of surplus capacitors, that were arranged in series parallel, for a combined total capacity of 0.29 MFD. Each capacitor was rated at 0.22 MFD and 50 KVDC. Three capacitors were series connected for a string capacity of 0.073 MFD. at 150 KVDC rating. Up to four strings could be parallel connected. With three strings in parallel, the combined rating was 0.22 MFD at 150 KVDC. These capacitors utilize poly-propylene film as the dielectric. The Extra Coil output discharge length improved with this set of capacitors, compared to the origional group, however it was felt that a polypropylene capacitor bank made of new units specifically built for pulsed r.f. oscillator circuit service, would yeild the best possible results. Ten new capacitors, each rated at 0.1 MFD and 50 KV pulse, were ordered and series-parallel connected for a combined total capacity of 0.25 MFD at 100 KV pulse. The new capacitors proved to be the most efficient on an input KVa vs. discharge length basis. Throughout this testing session, the following capacities were experimented with: 0.16, 0.21, 0.22, 0.29, 0.25, and lastly, 0.275 MFD. The latter proved to be the optimum capacity for the primary resonant tank circuit. In addition to varying the capacitance value, the primary inductance was changed from two single parallel connected turns to a single two-turn configuration. The spacing was adjusted between the primary winding and the secondary from a radius of 12.0 inches to 10.0 inches. At this spacing, the rotary gap dwell time was deemed too long in duration at 25 micro-seconds, and was reset at 12.0 inch radius. Additional turns were added to the base of the secondary coil, which resulted in extreme D'Arsonval discharge breakdowns between adjacent turns. These were so distructive as to melt and sever portions of the #4 AWG wire. After extensive and systematic changes were exhausted, the origional Master Oscillator specification was restored, and run with the finalized capacity of 0.275 MFD.

At this point, the Extra Coil was capable of delivering discharges from about 40 to in some cases, over 55 feet in length. Calculations based on the actual input power, the voltage under load supplied to the capacitor bank, the total series inductance value of secondary, transmission line and extra coil, the total capacitance of these, and the repetition rate of the rotary gap, show an output discharge rate of 39 arcs/second at 40 feet in length. The calculated energy of each spark is 0.833 KW, which is 32.4 KW/second.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

It must be borne in mind that the location of this test site is a major Los Angeles market A.M. transmitter and antenna farm location. The Model 13M Magnifier system was physically located in the near-field radiation pattern of the transmitter antenna farm. The five tower 3/8 lambda phased array antenna system provides over 8 dBi gain, so that even at reduced power for night time transmission (20 KW input), actual inductance or capacitance measurements on the Model 13M Magnifier system were not possible. However, frequency and time domain measurements were conducted during the operational sessions of testing this Tesla magnifier. Specifically, for frequency domain measurements, an HP-8563A spectrum analyzer and an HP-3561A dynamic signal analyzer were used to measure power spectral density (PSD). Time domain measurements were carried out with a Tektronix 468 digital storage oscilloscope. Calibrated antenna probes were used for all measurements except in the case of the Tek-468, which used a simple "gimmic" vertical wire probe. The plotted results of the HP-3561A and the Tek-468 are shown at the end of this paper. The HP-3561A graphs show the spectral content of 13M to be fairly broad in frequency, with two distinctive peaks at approximately 75 KHz and 87 KHz. The shifts shown in the four graphs reproduced, reflect changes in tuning due to varying the primary tank capacitance. The final graph labeled "last run 9:40 p.m." represent 0.275 MFD tank capacity, and agrees well with the HP-8563A result in photo #4. The illustrations in photos #1-3 are taken from the Tek-468 storage scope. Photo #1 specs: vertical input attn.= max. variable @ 50 volt/division and a horizontal sweep rate of 5 us./divison. Photo #2 specs: vertical input same as photo #1 and horizontal sweep 2 us./division. Photo #3 as above, with 20 us./division. Analysis of photo #1 shows the rotary gap commutating over a 20 us. period, followed by primary coil ring time out to 50 us. Photo #2 shows an expanded horizontal scale to reveal more detail in the rotary gap multiple firing process reproduced at 2 us./horizontal division. Photo #3 at 20 us./ horizontal division, shows the Master Oscillator primary coil ring, followed by the first oscillatory wave train responce of the secondary coil. All of the above measurements were conducted on August 19, 1995, and were taken using the second set of surplus capacitors. No measurements were made using the new third set of capcitors, which is unfortunate, as the latter clearly proved to be superior in performance. Following the last series of demonstrations and tests at the end of November 1995, the entire system was dismantled and placed in storage, and has remained as such, to this date.

FUTURE PLANS AND FURTHER MODIFICATIONS.

Another test session is planned for the latter part of 1996. At this time, it is not clear if the location will be the same as the first and third test sessions. In any case, the following is a list of planned improvements and modifications, that may result in this system's performance with arc lengths approching 60-75 feet in length.

1) Raise the Extra Coil elevation above ground from the present 76 inches to 108 inches by the addition of a third porcelain pedestal insulator to each of the four supports. This will aid in decoupling the coil from the ground plane and raise the height above ground of the transmission line, which will reduce the number of D'Arsonval discharges from this line to ground.

2) Add more electrostatic capacity to the existing 8 foot diameter toroid discharge electode. This will be accomplished by the inclusion of a 24 inch diameter aluminum sphere, placed above the center of the top of the toroid, with approximately 36 inches spacing. It seems clear that the 8 foot diameter toroid alone is not the optimum capacity for the Extra Coil to load into. However, it was the largest size that could be ordered. By adding the sphere, and placing it properly above the toroid, the Faraday effect between the two bodies will effectivly increase the surface area and therefore total capacity.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

3) Design and construct a sulpher hexifloride (SF6) pressurized gap, to be series connected to the existing rotary gap. This will allow an adjustable commutation time from about 25 us. down to less then 15 us. It will also allow higher capacitor charging voltages before gap firing, increasing the energy per pulse that is delivered to the Master Oscillator.

4) Increase the KVa capacity of the 2-bay rack cabinet power supply controller, from its current maximum capacity of 100 KVa to 150 KVa. This will be accomplished by the addition of three more autotransformers to the voltage control and current control stacks, raising the total from 12 to 18 units. This will be necessary in order to take full advantage of the higher energy operating capability afforded by the addition of the series SF6 pressurized gap.

5) Select a new test site for the fourth testing session that is in a low r.f. environment, to afford a real opportunity to conduct accurate test measurements of both system capacitance and inductance. This can only be done in a quiet ambient r.f. radiation location.

6) One of the most provocative research objectives, that was part of the origional imputus for constructing this project, was the idea of using such an apparatus to initiate triggered lightning. With the equipment predisposed in a good location under a densely charged cloud formation, this author believes that this equipment will pose as a viable alternative to the use of small rockets with trailing wires. This attempt may also aid in initiating natural ball lightning phenomena.

CREDITS.

The construction of the Model 13M Magnifier Tesla Coil system was and continues to be, a team effort. Many individuals contributed their time and talent to produce the results achieved to date. Acknowledgement of the members of this team is appropriate. The financial partners mentioned in the beginning of this paper are a consortium of individuals from Rosen's Electrical Equipment Company Incorporated, of Pico Rivera, California. Virtually all of the components and materials used to construct 13M were supplied by or through this company. It is through their continuing support, that this project has a future. Other people who are due a great deal of credit are: Lee Roan-W6GQE, who served as shop foreman, master craftsman, and contributed greatly to the final physical design of the Master Oscillator and Extra Coil framework. Scot Barth-KA6UDZ, Steve Harris-KD6LAJ, Tony Chillemi-KD6IFC, Rosalee Sorrell-KD6KSG, and Frank Decker, all of whom traveled to Colorado Springs in July, 1994, in addition to helping build and test 13M in Southern California. Matt Mendenhall-KE6ALM, Dave Qualls-K6AYK, Rick Barrett-KE6DKF, Scott Booth-KC6TTR, David Ping-KK6GH and Richard Silvera-KC6YQD (the chief and assistant chief engineers of Greater Los Angeles Radio-KRLA). Jim Hardesty-N2DRT, who has always helped at Colorado Springs. Don Teep, James T. Shaffer, for machine work on the rotary gap, Martin Bottjer, Dr. James F. Corum, and Dr. Robert B. Dybdal, and perhaps most importantly, Brad Norman, who has always helped with each ITS symposium (and almost single-handedly saved Model 13M from being lost in the mud at Penrose Stadium.)

Company acknowledgement is made to The O. W. Landergren Company, for providing the 8 foot diameter toroid, Hipotronics Incorporated, for providing the polypropylene capacitors, Greater Los Angeles Radio, Incorporated, for providing the test site in Southern California, and The International Tesla Society, Incorporated, for providing the opportunity to exhibit Model 13M in Colorado Springs, 1994.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

REFERENCES.

1) Kotter, R.F., Smith, A.N., "A Study of Air-Gap Breakdown at 28.5 Kilohertz." IEEE Trans. PAS Vol. PAS-102, No.6 (1983) 1913.

2) Corum, J.F., Corum, K.L., "A Technical Analysis of the Extra Coil as a Slow Wave Helical Resonator." Proceedings of the 1986 International Tesla Symposium, International Tesla Society, Inc., 1986, PP. 2-1 to 2-24.

3) Corum, J.F., Corum, K.L., "Tesla Coils-An RF Power Processing Tutorial For Engineers." Proceedings of the 1988 International Tesla Symposium, International Tesla Society, Inc., 1988, PP. 2-8 to 2-48.

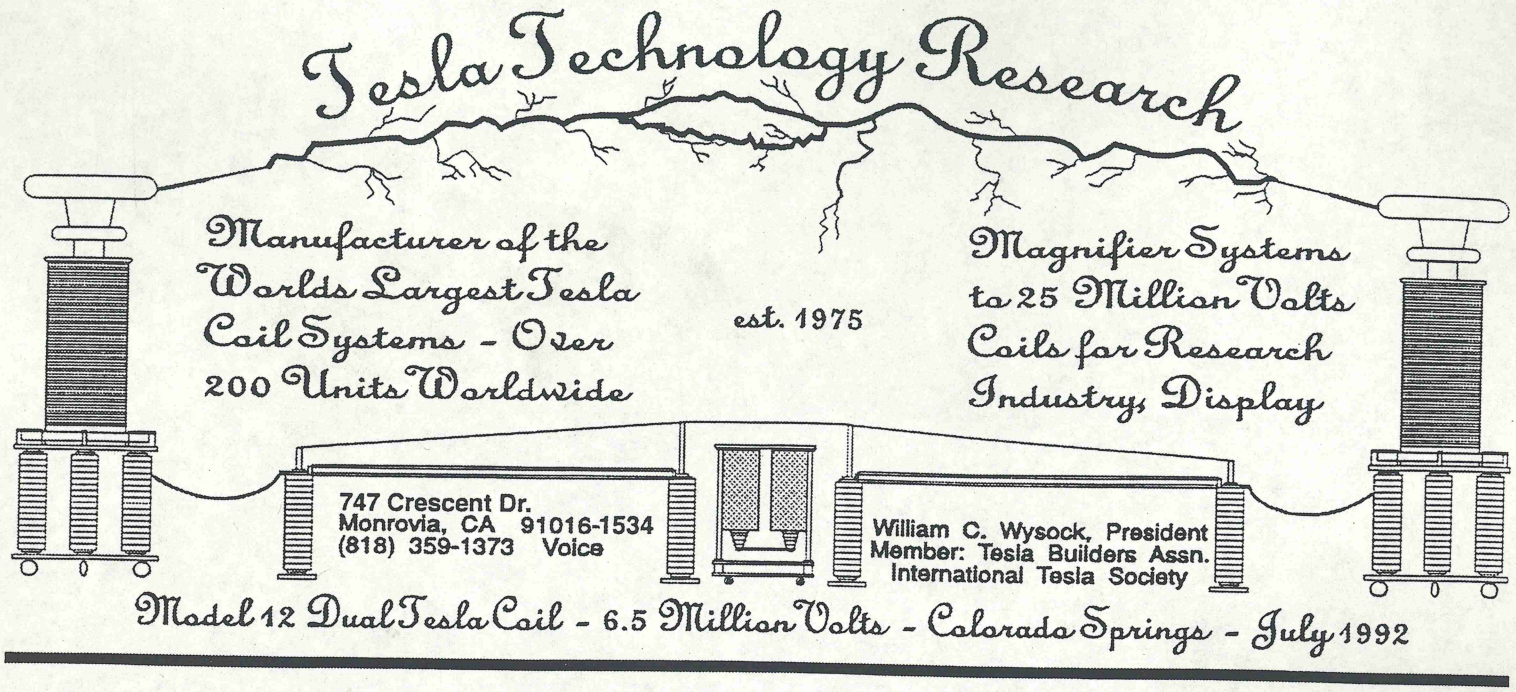
4) Anderson, L.I., "Nikola Tesla On His Work With Alternating Currents and Their Application to Wireless Telegraphy, Telephony, and Transmission of Power." Sun Publishing, Denver Colorado, 1992, PP. 48-179, Appendix II, PP. 169-179.

5) Wysock, W.C., "Modern Spark Gap Technology." Proceedings of the Extraordinary Science Symposium 1991, International Tesla Society, Inc., 1991.

ILLUSTRATIONS.

1) Model 14M Magnifier System, side view.
2) Model 14M Magnifier Primary and Secondary Coil Support Frame, plan view.
3) Model 14M Magnifier Primary and Secondary Coil Form, plan view.
4) Model 14M Secondary Coil Outer-most Helix Bobin Support, side view.
5) Model 14M Secondary Coil: 1st Secondary Winding, side view.
6) Model 14M Extra Coil Detail, side view.
7) Model 13M Magnifier System, side view.
8) Model 13M Magnifier Primary and Secondary Coil Assembly, side view.
9) Model 13M Magnifier Primary and Secondary Coil Form, bottom view
10) Model 13M Magnifier Primary and Secondary Coil Form, side view.
11) Model 13M Extra Coil Assembly, side view.
12) Model 13M Extra Coil Detail, side view.
13) Model 13M Secondary and Extra Coil Detail, side view.
14) Model 13M Schematic.
15) Model 13M Comparison notes vs.Colorado Springs Notes (CSN)
16) Model 13M Calculations.
17) Model 13M Power Spectral Density (PSD), HP-3561A Dynamic Signal Analyzer.
18) Model 13M Frequency Domain Measurements, HP-8563A Spectrum Analuzer.
19) Model 13M Time Domaim Measurements, Tek-468 Digital Storage Oscilloscope.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



1.) INTRODUCTION AND BACKGROUND: DESIGN OF MODEL 14M MAGNIFIER.
DESIGN OF MODEL 13M MAGNIFIER.

2.) ATTEMPTED EXHIBITION OF 13M AT COLORADO SPRINGS, JULY 22, 1994.

3.) FUTURE PLANS AND FURTHER MODIFICATIONS OF THE 13M MAGNIFER.

4.) QUESTIONS AND ANSWERS.

5.) EPILOG: A PERSONAL OPINION; WILL WE ALLOW HISTORY TO BE REWRITTEN?

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. Wysock-N6UXW
Tesla Technology Research
747 Crescent Drive
Monrovia, CA 91016-1534
(818) 359-1373

DESIGN, CONSTRUCTION AND TESTING OF A LARGE SCALE MAGNIFIER-TYPE TESLA COIL SYSTEM

"I actually used in all these three forms, almost every day, all these devices; and furthermore, I had other methods which are not yet patented, and those are corking fine methods." N. Tesla. [4]

1.) INTRODUCTION AND BACKGROUND.

In January 1994, the design for a scaled version of Tesla's famous 1899 Colorado Springs magnifier coil was conceived. The goals were to use modern construction techniques and materials as an integral part of the overall coil design, seek financial sponsorship to assist in funding the projcet, and finally, build and test the system in time for exhibition at the 1994 International Tesla Symposium. The origional design for the Master Oscillator, (Tesla primary and secondary coils), was to be a multi-layerd archimedian flat spiral that would be 20 feet in diameter. The framework supporting these two coils was to be made of fiberglass and form a framework that could be bolted together on location, and would elevate the horizontal plane of the primary and secondary coils 20 feet high above ground. The electrical and physical advantages of this design over Tesla's 49.25 foot diameter helical-wound primary and secondary coils as used in 1899, are well known. Even Tesla had previous practical experience with this form of r.f. transformer winding technique, as witnessed from photographs in his Houston Street laboratory prior to the Colorado Springs development work, and again at Wardenclyffe; Tesla used flat spiral transformer designs. These advantages are the ability to control the voltage gradient distribution along the secondary winding, and an improved coupling coefficient between the primary and secondary, where the primary is wound about the circumference of the outer diameter of the secondary coil, which is the ground point of the secondary. This places the largest amount of secondary coil inductance in a closer magnetically coupled influence of the primary winding, thereby increasing mutual coupling between the two windings, producing higher energy transfer efficiency.

In a high frequency, high voltage transformer, E-field or voltage gradient control becomes a serious concern. Corona losses need to be eliminated or minimized in order to to achieve maximum transformer efficiency. In a flat spiral secondary construction where the low voltage or ground point is at the periphery, the high voltage point will be at the center of the spiral. The electromagnetic fields set up in this type of winding produce a Faraday shielding effect on successive turns, reducing stray corona leakage. In Tesla's early development work, this form of control was experimented with, as well as other methods, such as enclosing the entire transformer in oil. It is interesting to note that the modern-day automotive ignition coil (for which Tesla received a patient,) combined the attributes of a primary winding around concentric layers of secondary windings, the high voltage end of which is at the center of the winding, and is electrically connected to a silicon steel laminated core. This core material increases the permeability of both windings and, along with the whole assembly being contained in oil, provides a design of smallest size and highest efficiency.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

In a Tesla transformer of much higher input power and size, it becomes impractical to employ oil or any ferrous core material. However,the fore-mentioned coupling efficiency of the concentric layer approch with the high voltage end at the center of the construction, becomes a very attractive design feature. The origional design for a scale version of the 1899 project using this principle was presented to prospective financiers in February, 1994. It was deemed too expensive and physically large to handle, within the time and budgetary constraints that were imposed. Thus, Model 14M, as this design was dubbed, had to be shelved. In its place, an even smaller design Master Oscillator was substituted of much the same construction as Tesla utilized in 1899. This second design would be 1/5 scale in size and amount of inductance in the primary and secondary windings, as compaired to Colorado Springs. The secondary winding would therefore be a single layer helical winding on an open framework. Wood was substituted in this new design instead of fiberglass, in order to further reduce anticipated construction costs. Of all the available types of wood, Sitka spruce was the most desirable (and expensive!) This is the same type wood that large power transformer manufacturers utilize as coil supports in their construction. This wood comes only from Alaska and sells for about $3.00 per linear foot. The physical and electrical attributes of this type of wood are that it is a straight-grained closed-cell growth dense wood, and when properly kiln dried and varnished, makes an excellent insulation support material that is easily machinable, with a low dielectric loss tangent, even at moderately high frequencies and very high voltages. More then $4,000.00 of this material was procured for use as the Master Oscillator upright supports, and the squirrel cage structure for the tertiary or Extra coil form. The lower support framework supporting each coil structure was made from clear Douglas fir and pine wood.

The 1/5 scale version Master Oscillator design was to employ a moderately high degree of mutual coupling between the primary and secondary windings, due to close physical spacing, and decoupling both windings from excessive loading against the ground plane, by physically elevating both windings. The high value of M (mutual coupling), implied a need for a very short dwell or commutation time of the rotary spark gap, or "rotary break," as Tesla referred to in his Colorado Springs diary notes. The commutation time that was determined as optimal, was on the order of 15 microseconds. Designing and building a rotary gap to handle very high levels of input power and voltage, yet provide very short pulse durations, proved to be sizable design challenges.

The inital concept for the rotary gap centered on the use of a salient-pole syncronous motor. The origional planned A.C. power input level was to be on the order of 50 KW, with a tank circuit charging voltage up to 60 KV. In order to handle high power and voltage levels, yet produce very short commutation dwell times, the physical size of the spark gap was dictated by the rotating velocity required of the rotary electrodes. These electrodes were configured as dual pairs of 0.50 inch diameter thoriated tungsten round rods with hemi-sperical ends, mounted in the ends of a pair of aluminum rotating arms on a common dirveshaft. The stationary electrodes were also dual pairs of the same construction, placed 90 degrees apart at fixed locations around the rotary arms. The geometry of the electrodes with their hemispherical ends and a design speed of 3,600 r.p.m. on the driveshaft, determined the radius of rotation needed to achieve a mechanical dwell duration that approched the origional design goal of 15 microseconds. This design had to be compromised somewhat, due to the cost of materials and manufacturing, and practical limitations of available torque from the drive motor, to turn the driveshaft and rotary arms at a speed of 3,600 r.p.m.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

Two design apporches to couple power from the motor shaft to the driveshaft were considered; direct-coupled insulated shafting and positive drive belting on electrically and mechanically decoupled shafts. The latter was chosen for the advantages of reduced size and fewer mechanical design problems. A flat positive drive timing belt with a 10 horsepower at 3,600 r.p.m. rating was obtained and phenolic positive drive pulleys for both the motor and rotary arm shafts were fabricated, as well as a phenolic idler pulley to take up torque induced slack on the return side of the belt. This belt exhibits sufficient electrical insulation qualities such that the leakage current to ground from the rotary arm driveshaft is limited to about 3.5 milliamps with 50 KV on the rotary arm driveshaft.

The rotary arms were sized to rotate about a 24 inch diameter circle, circumscribed by the hemispherical tips of the tungsten rotary electodes. This arrangment limits the spark dwell time from the rotary electrodes to each group of stationary electrodes to the order of 25 microseconds at 3,600 r.p.m. To further reduce spark dwell time, the enclosure housing of the rotary gap was designed to be pressurized with nitrogen gas up to 30 p.s.i. One inch thick clear plexiglas sheeting was chosen for the enclosure material, which offered the advantages of ease in machining, mechanical strength, and the ability to visually observe the performance of the gap while energized.

The origional design capacity for the resonant tank circuit consisting of a capacitor bank, rotary break, and Master Oscillator primary inductance was 0.16 MFD at 50 KVAC-RMS, from four Cornell-Dublier phenolic case pulse units that were obtained surplus. It was not known what dielectric material was used in these units; i.e., mica, mylar or other type of plastic film. The ESR (equivilent series resistance), was measured and the dissapation factor of each unit was rated at 0.36. Additional capacitors were made available to allow for testing with different values of primary tank capacity.

The Master Oscillator primary inductance is constructed from two parallel-connected single turn coils of 500 MCM welding cable, and placed about the periphery of the Sitka spruce upright supports, that form the framework for the secondary coil. The primary coil is 12 feet in diameter, and the center-to-center spacing of the two single turns is set at 4.5 inches. This same type cable is used exclusively for all inter-connect wiring, along with 4 inch wide copper straping for the capacitor bank. The coil form made of Sitka spruce, is supported on a framework of clear Douglas fir framing, elevated 4 feet above ground on 4 porcelain pedistal type insulators. The radius between the vertical centerline of the primary and secondary windings is set at 12 inches. However, provision is made for reducing this distance. The vertical offset between the horizontal centerline of the primary to the first turn of the secondary winding is set at 2 inches, and is also designed for adjustment. The secondary winding consists of 30 turns of mil-spec #4 AWG stranded insulated cable with a 105 degree C heat rating. These turns are spaced 1.8 inches apart, and the diameter of this helical winding on its Sitka spruce squirrel cage form set at 10 feet. The final top turn is connected to a toroid capacity terminal ring 10 feet, 8 inches in diameter, with a cross section of 4 inches. This ring is fabricated from smooth outside wall, light galvanized flexible steel tubing. The toroid ring serves two purposes; to provide an electrostatic capacitive load to the output of the secondary winding and to eliminate the possibility of corona streamer leakage. The transmission line or interconnecting link between the output of the secondary winding to the input of the Extra Coil, is also made of this material. The transmission line is 45 feet in length, the distance between the facing sides of the two coil assemblies. The design of the Master Oscillator coil has proven most effective and satisfactory in all operations.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The Extra Coil which is treated as a self-resonant inductance, utilizes the same construction and materials as in the Master Oscillator. The helical coil form is fabricated from Sitka spruce and three 5 foot diameter fiberglass flat discs. The coil form is 5 feet in diameter and 10 feet in length. 150 turns of #8 AWG mil-spec insulated stranded cable are wound with a spacing of 0.8 inches per turn. 4 inch diameter flexible steel tubing form corona supression toroid rings and are used as both the first and last turn of the inductance on this coil. A phenolic tube spacer 3 feet in height and 2 feet in diameter is used to support the main toroid discharge terminal. This terminal is hollow spun aluminum, 8 feet in diameter and 30 inches in cross-section. The Extra Coil is supported on a douglas fir wood framework and mounted on a porcelain insulator stand 6 feet 4 inches in height. The overall height of the Extra Coil assembly is 20 feet 4 inches or 6.2 meters.

The origional high voltage power supply transformer was nameplate rated as a 25 KVa unit, with tap positions on the low voltage winding corresponding to an output voltage up to 60 KV. The construction of this unit was thought to be conservatively built such that for short periods of operation, its KVa rating could be increased two fold, to 50 KVa. In the origional testing of this system at Southern California, it was discovered that indeed the core of this transformer went into complete saturation above the 25 KVa level. Therefore, all of the first (alpha) tests conducted on this system were limited to a maximum a.c. input of 25 KVa. These tests took place between July 16-18, 1994. Due to the shortness of available time, the initial proof-of-performance testing was all that could be accomplished, prior to loading the entire system into a 51 foot long 10 foot high container, for transport to Colorado Springs.

The equipment arrived at Colorado Springs at 9 p.m. on July 20, 1994. The intended exhibit site was to be an outdoor equestrian area known as Penrose Stadium. Setup of the equipment commenced at 7 a.m. on July 21, and the date for exhibit was set as Saturday, July 22. A seperate power supply transformer was ordered from a firm in Arkansas, and was scheduled for arrival on July 20 at the exhibit location. This second transformer is a 100KVa unit that stands 8 feet high, weighs approximately 2,500 pounds, and is rated for 240/480 low voltage and 36 KV high voltage. To energize this unit, the ITS planning committee arranged to have a 138 KVa stepdown transformer on location, to connect the stadium's mains at 480 volt down to 240 volt, which is the required input voltage for the custom made 2-bay rack cabinet power supply controller. The physical setup of the Model 13M system requires a work crew of 6, a fork lift, a bucket truck, and a crane. It requires approximately 8 hours, simply to accomplish the physical construction of this equipment. In a large apparatus such as 13M, electrical characteristics and tuning are always widely influenced by the surrounding immediate invironment. The reflectivity and conductivity of Colorado's red clay-like earth behaves very differently as compared to the asphalt surface of the (alpha) test site in Southern California and represented significant tuning changes. Perhaps most importantly, the integrity of a master ground reference for the input of the Master Oscillator's secondary coil, was questionable. At the (alpha) test site, the location of a 50KW A.M. radio transmitter installation, with its vast ground point and radial counterpoise system feeding a 5 tower phased array, was available for a master ground reference. At Penrose Stadium, only a series of galvanized steel posts as perimiter fencing was accessable. No ground resistivity tests were possible at either location, due to the short amount of time available. At Penrose, all the equipment was set up on sheets of 3/4 inch thick, 4 foot by 8 foot plywood, which lay upon the dirt surface of the stadium floor.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MURPHY'S LAW AND OTHER ANOMALIES.

The equipment setup started the morning of July 21 at Penrose Stadium. NOAA weather servies as well as the Air Force base weather data forecast mild temperatures and light wind conditions. All of the equipment was [finally] ready for initial power-up testing as of 11 p.m. The night sky was clear and the temperature had dropped into the low 70's. The rotary gap motor which is slowly raised from 0 up to the running speed of 3,600 r.p.m. by means of a 15 KVa autotransformer, was energized. As the rotary gap approched about 1,800 r.p.m., there was a sudden violent vibration observed, and the emergency E-stop control was activated. A close inspection of the gap showed that the 10 h.p. motor was loose on its mounting bolts, causing the positive drive belt to skip as the motor was physically raised up off its mounts by the increase in torque. This in turn, caused the thoriated tungsten rotary electrodes to come in distructive contact with the stationary electrodes, shattering six of these $200.00 rods. In an emergency attempt to salvage what was left, the plexiglass housing had to be field-stripped, the sheared-off electodes removed, the rotary arms re-balanced with only single electrodes in their two ends, the debris removed from the interior of the 1 inch thick enclosure, and then reassembled. At about 2 a.m. on Saturday July 22, the system was finally ready to be tested.

Several important changes were incorporated in this [beta] test; 1) The origional 25 KVa transformer was now replaced by a 100 KVa unit. 2) The mains source could supply up to 138 KVa, instead of only 50 KVa, the limit at the [alpha] test site. 3) For the first time, the use of nitrogen gas to reduce spark gap dwell time, by pressurizing the rotary gap enclosure up to 15 p.s.i., was included. As the system was powered up [successfully] for the first time and slowly raised to about 80 KVa input, long streamer discharges were observed emanating from the 8 foot diameter toroid discharge terminal. These appeared to approximately 25-30 feet in length. Also observed were several heavy [D'Arsonval] type discharges about 8 feet in length, going from the trans-mission line to ground, at a point approximately 15 feet before the input to the Extra Coil. This was the same type phenomena shown in photographs of Tesla's 1899 machinery. This power-up test lasted for about one minute. The system was then powered down and the equipment inspected. The rotary spark gap enclosure exhibited a dark orange-yellow color to its interior; the result of the nitrogen gas recombining into nitric oxide. As the work crew approched the location of the spark gap for a closer look, the plexiglass enclosure began to develop a large quantity of heat stress cracks at most of the 3/8-16 threaded bolt centers; the result of intense temperature difference between the interior and exterior of the enclosure. It was estimated that the interior temperature had raised over the one minutes' operation at the 80 KW level, from ambient to above 400 degrees F. This observation was validated by virtue of the fact that the phenolic plates that locate the stationary electrode assemblies around the rotary arms, were bubbled on their surfaces and exhibited resin seepage. This observed condition had not been previously encountered at the [alpha] test site undoubtedly because of the significantly lower input power level. Since the system appeared to be usable, in spite of the setbacks encountered, it was decided to stop work for the night and make additional repairs to the rotary gap later in the morning. Several members of the ITS staff volunteered to keep watch over the equipment for the remainder of the night.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THE "FIFTY YEAR STORM" AT PENROSE STADIUM.

At 9 a.m. July 22, a local machine shop was contacted to provide six centerless ground 0.5 inch diameter replacement electrodes with hemispherical ends. These were only available in tungsten-carbide instead of thoriated tungsten. The top plexiglass enclosure plate had been removed and machined so that three venting holes could be bored, to increase hot air exhausting from the gap enclosure interior. As the work progressed, the skies over Colorado Springs became overcast and it began to sprinkle. A check with the weather services indicated a "slight" low pressure front was moving through the area and the updated forecast was for clearing by afternoon. As the noon hour approached however, this "slight" weather front had intensified and became a catagory 1 force storm with gail winds sustained above 70 m.p.h., intense lightning, hail balls 1 inch in diameter, and a downpour of rain that flooded many sections of the area. It was reported that over 6 inches of rain fell in less then 4 hours. The storm appeared to be most intense in the foothill area, where Penrose Stadium is located. The group of volunteers from ITS keeping watch over night on the equipment at the stadium, had attempted to cover the equipment with plastic sheeting. This effort was wasted; all the equipment was covered in red-clay mud and was thoroughly soaked. Standing water up to six inches deep turned the earthen floor of the stadium into a small lake. The storm cleared by about 6:30 p.m., and a close inspection of the equipment resulted in the decision to cancel what was billed as "The All American Electrical Show", which was to have started at 8 p.m. that evening. As it turned out, a second storm came over the area later that night, dumping an additional three inches or so of rain. Long term residents of the area referred to this event as "the fifty year storm".

IT'S NOT NICE TO FOOL MOTHER NATURE.

Sunday morning, July 23, the weather was again clear and mild. Further inspection of the equipment at the stadium was impossible; even the forklift with its large pneumatic tractor-type tires could not maneuver, even at the end of the day. It would be two more days of mild weather before the earthen floor of the stadium dried out enough to move the machinery and equipment. One week later, the [damaged] equipment that comprised Model 13M, arrived via a flat bed tractor-trailer rig, back in Southern Calififornia. From there, the equipment was placed in storage for 12 months, until July 3, 1995.

LESSONS LEARNED (TAKE THREE).

As in any scale Tesla coil system, it is imperative to limit the number of unknown characteristics or variables during development and testing. Ideally, only one parameter is adjusted at a time, noting the results and moving on until all the variables are optimized. This is particularly possible where there is sufficient control over the environment and sufficient time to carry out the development process. On this basis, after the winter rainy season was concluded in Southern California, the Model 13M Magnifier was [again] set up at the broadcast a.m. transmitter site, beginning July 3, 1995 and ending in late November. The weather at this location allowed the possibilty of having the entire system set up outdoors with minimum risk of weather damage.

The a.c. power mains supplied to the transmitter site is 480 volt 60 Hz, 3 phase. Each leg is rated at 300 amps continuous load at this voltage. A new stepdown transformer rated at 480/240 volt and 150 KVa was used to supply power to the 2-bay rack cabinet controller for 13M. A seperate safety lockout disconnect switch from the mains buss and a 300 amp 480 volt breaker switch insured adequate personnel safety. A comprehensive testing and development program for the Model 13M Magnifier Tesla Coil was now possible.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

The first order of business was to redesign and construct the rotary gap, to handle 100 KVa a.c. power input, without overheating. The idea of using pressurized nitrogen gas to reduce the gap dwell time and quench the arc, was abandoned. In its place, a dual chamber squirrel cage blower directed air into a combined plenum box and then force-fed air into the bottom of the rotary gap enclosure. Care was taken in insuring the direction of air flow matched the rotational direction of the rotary arms. The rotary arms were redesigned with different electrode angles, and the new thoriated tungsten electrodes were electrical discharge machined (EDM) for cross-drilled press fit wrist pins, to insure positive locking of these electrodes in the ends of the rotary arms. The stationary electrode holders were modified to include large surface area aluminum heat sinks for cooling. The tungsten electrodes used in these holders were diamond ground for captive flats on their sides, to insure positive locking with set screws. The phenolic sheets that supported the stationary electrode assemblies were replaced with G-10 epoxy-fiberglass plates. These plates have a considerably higher temperature immunity and physical strength, compared to phenolic.

The origional capacitor bank consisting of a 0.16 MFD 50 KV AC RMS unit was still employed when the third test operations began on July 5, 1995. This group was eventually replaced with a second group of surplus capacitors, that were arranged in series parallel, for a combined total capacity of 0.29 MFD. Each capacitor was rated at 0.22 MFD and 50 KVDC. Three capacitors were series connected for a string capacity of 0.073 MFD. at 150 KVDC rating. Up to four strings could be parallel connected. With three strings in parallel, the combined rating was 0.22 MFD at 150 KVDC. These capacitors utilize poly-propylene film as the dielectric. The Extra Coil output discharge length improved with this set of capacitors, compared to the origional group, however it was felt that a polypropylene capacitor bank made of new units specifically built for pulsed r.f. oscillator circuit service, would yeild the best possible results. Ten new capacitors, each rated at 0.1 MFD and 50 KV pulse, were ordered and series-parallel connected for a combined total capacity of 0.25 MFD at 100 KV pulse. The new capacitors proved to be the most efficient on an input KVa vs. discharge length basis. Throughout this testing session, the following capacities were experimented with: 0.16, 0.21, 0.22, 0.29, 0.25, and lastly, 0.275 MFD. The latter proved to be the optimum capacity for the primary resonant tank circuit. In addition to varying the capacitance value, the primary inductance was changed from two single parallel connected turns to a single two-turn configuration. The spacing was adjusted between the primary winding and the secondary from a radius of 12.0 inches to 10.0 inches. At this spacing, the rotary gap dwell time was deemed too long in duration at 25 micro-seconds, and was reset at 12.0 inch radius. Additional turns were added to the base of the secondary coil, which resulted in extreme D'Arsonval discharge breakdowns between adjacent turns. These were so distructive as to melt and sever portions of the #4 AWG wire. After extensive and systematic changes were exhausted, the origional Master Oscillator specification was restored, and run with the finalized capacity of 0.275 MFD.

At this point, the Extra Coil was capable of delivering discharges from about 40 to in some cases, over 55 feet in length. Calculations based on the actual input power, the voltage under load supplied to the capacitor bank, the total series inductance value of secondary, transmission line and extra coil, the total capacitance of these, and the repetition rate of the rotary gap, show an output discharge rate of 39 arcs/second at 40 feet in length. The calculated energy of each spark is 0.833 KW, which is 32.4 KW/second.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

It must be borne in mind that the location of this test site is a major Los Angeles market A.M. transmitter and antenna farm location. The Model 13M Magnifier system was physically located in the near-field radiation pattern of the transmitter antenna farm. The five tower 3/8 lambda phased array antenna system provides over 8 dBi gain, so that even at reduced power for night time transmission (20 KW input), actual inductance or capacitance measurements on the Model 13M Magnifier system were not possible. However, frequency and time domain measurements were conducted during the operational sessions of testing this Tesla magnifier. Specifically, for frequency domain measurements, an HP-8563A spectrum analyzer and an HP-3561A dynamic signal analyzer were used to measure power spectral density (PSD). Time domain measurements were carried out with a Tektronix 468 digital storage oscilloscope. Calibrated antenna probes were used for all measurements except in the case of the Tek-468, which used a simple "gimmic" vertical wire probe. The plotted results of the HP-3561A and the Tek-468 are shown at the end of this paper. The HP-3561A graphs show the spectral content of 13M to be fairly broad in frequency, with two distinctive peaks at approximately 75 KHz and 87 KHz. The shifts shown in the four graphs reproduced, reflect changes in tuning due to varying the primary tank capacitance. The final graph labeled "last run 9:40 p.m." represent 0.275 MFD tank capacity, and agrees well with the HP-8563A result in photo #4. The illustrations in photos #1-3 are taken from the Tek-468 storage scope. Photo #1 specs: vertical input attn.= max. variable @ 50 volt/division and a horizontal sweep rate of 5 us./divison. Photo #2 specs: vertical input same as photo #1 and horizontal sweep 2 us./division. Photo #3 as above, with 20 us./division. Analysis of photo #1 shows the rotary gap commutating over a 20 us. period, followed by primary coil ring time out to 50 us. Photo #2 shows an expanded horizontal scale to reveal more detail in the rotary gap multiple firing process reproduced at 2 us./horizontal division. Photo #3 at 20 us./ horizontal division, shows the Master Oscillator primary coil ring, followed by the first oscillatory wave train responce of the secondary coil. All of the above measurements were conducted on August 19, 1995, and were taken using the second set of surplus capacitors. No measurements were made using the new third set of capcitors, which is unfortunate, as the latter clearly proved to be superior in performance. Following the last series of demonstrations and tests at the end of November 1995, the entire system was dismantled and placed in storage, and has remained as such, to this date.

FUTURE PLANS AND FURTHER MODIFICATIONS.

Another test session is planned for the latter part of 1996. At this time, it is not clear if the location will be the same as the first and third test sessions. In any case, the following is a list of planned improvements and modifications, that may result in this system's performance with arc lengths approching 60-75 feet in length.

1) Raise the Extra Coil elevation above ground from the present 76 inches to 108 inches by the addition of a third porcelain pedestal insulator to each of the four supports. This will aid in decoupling the coil from the ground plane and raise the height above ground of the transmission line, which will reduce the number of D'Arsonval discharges from this line to ground.

2) Add more electrostatic capacity to the existing 8 foot diameter toroid discharge electode. This will be accomplished by the inclusion of a 24 inch diameter aluminum sphere, placed above the center of the top of the toroid, with approximately 36 inches spacing. It seems clear that the 8 foot diameter toroid alone is not the optimum capacity for the Extra Coil to load into. However, it was the largest size that could be ordered. By adding the sphere, and placing it properly above the toroid, the Faraday effect between the two bodies will effectivly increase the surface area and therefore total capacity.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

3) Design and construct a sulpher hexifloride (SF6) pressurized gap, to be series connected to the existing rotary gap. This will allow an adjustable commutation time from about 25 us. down to less then 15 us. It will also allow higher capacitor charging voltages before gap firing, increasing the energy per pulse that is delivered to the Master Oscillator.

4) Increase the KVa capacity of the 2-bay rack cabinet power supply controller, from its current maximum capacity of 100 KVa to 150 KVa. This will be accomplished by the addition of three more autotransformers to the voltage control and current control stacks, raising the total from 12 to 18 units. This will be necessary in order to take full advantage of the higher energy operating capability afforded by the addition of the series SF6 pressurized gap.

5) Select a new test site for the fourth testing session that is in a low r.f. environment, to afford a real opportunity to conduct accurate test measurements of both system capacitance and inductance. This can only be done in a quiet ambient r.f. radiation location.

6) One of the most provocative research objectives, that was part of the origional imputus for constructing this project, was the idea of using such an apparatus to initiate triggered lightning. With the equipment predisposed in a good location under a densely charged cloud formation, this author believes that this equipment will pose as a viable alternative to the use of small rockets with trailing wires. This attempt may also aid in initiating natural ball lightning phenomena.

CREDITS.

The construction of the Model 13M Magnifier Tesla Coil system was and continues to be, a team effort. Many individuals contributed their time and talent to produce the results achieved to date. Acknowledgement of the members of this team is appropriate. The financial partners mentioned in the beginning of this paper are a consortium of individuals from Rosen's Electrical Equipment Company Incorporated, of Pico Rivera, California. Virtually all of the components and materials used to construct 13M were supplied by or through this company. It is through their continuing support, that this project has a future. Other people who are due a great deal of credit are: Lee Roan-W6GQE, who served as shop foreman, master craftsman, and contributed greatly to the final physical design of the Master Oscillator and Extra Coil framework. Scot Barth-KA6UDZ, Steve Harris-KD6LAJ, Tony Chillemi-KD6IFC, Rosalee Sorrell-KD6KSG, and Frank Decker, all of whom traveled to Colorado Springs in July, 1994, in addition to helping build and test 13M in Southern California. Matt Mendenhall-KE6ALM, Dave Qualls-K6AYK, Rick Barrett-KE6DKF, Scott Booth-KC6TTR, David Ping-KK6GH and Richard Silvera-KC6YQD (the chief and assistant chief engineers of Greater Los Angeles Radio-KRLA). Jim Hardesty-N2DRT, who has always helped at Colorado Springs. Don Teep, James T. Shaffer, for machine work on the rotary gap, Martin Bottjer, Dr. James F. Corum, and Dr. Robert B. Dybdal, and perhaps most importantly, Brad Norman, who has always helped with each ITS symposium (and almost single-handedly saved Model 13M from being lost in the mud at Penrose Stadium.)

Company acknowledgement is made to The O. W. Landergren Company, for providing the 8 foot diameter toroid, Hipotronics Incorporated, for providing the polypropylene capacitors, Greater Los Angeles Radio, Incorporated, for providing the test site in Southern California, and The International Tesla Society, Incorporated, for providing the opportunity to exhibit Model 13M in Colorado Springs, 1994.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

REFERENCES.

1) Kotter, R.F., Smith, A.N., "A Study of Air-Gap Breakdown at 28.5 Kilohertz." IEEE Trans. PAS Vol. PAS-102, No.6 (1983) 1913.

2) Corum, J.F., Corum, K.L., "A Technical Analysis of the Extra Coil as a Slow Wave Helical Resonator." Proceedings of the 1986 International Tesla Symposium, International Tesla Society, Inc., 1986, PP. 2-1 to 2-24.

3) Corum, J.F., Corum, K.L., "Tesla Coils-An RF Power Processing Tutorial For Engineers." Proceedings of the 1988 International Tesla Symposium, International Tesla Society, Inc., 1988, PP. 2-8 to 2-48.

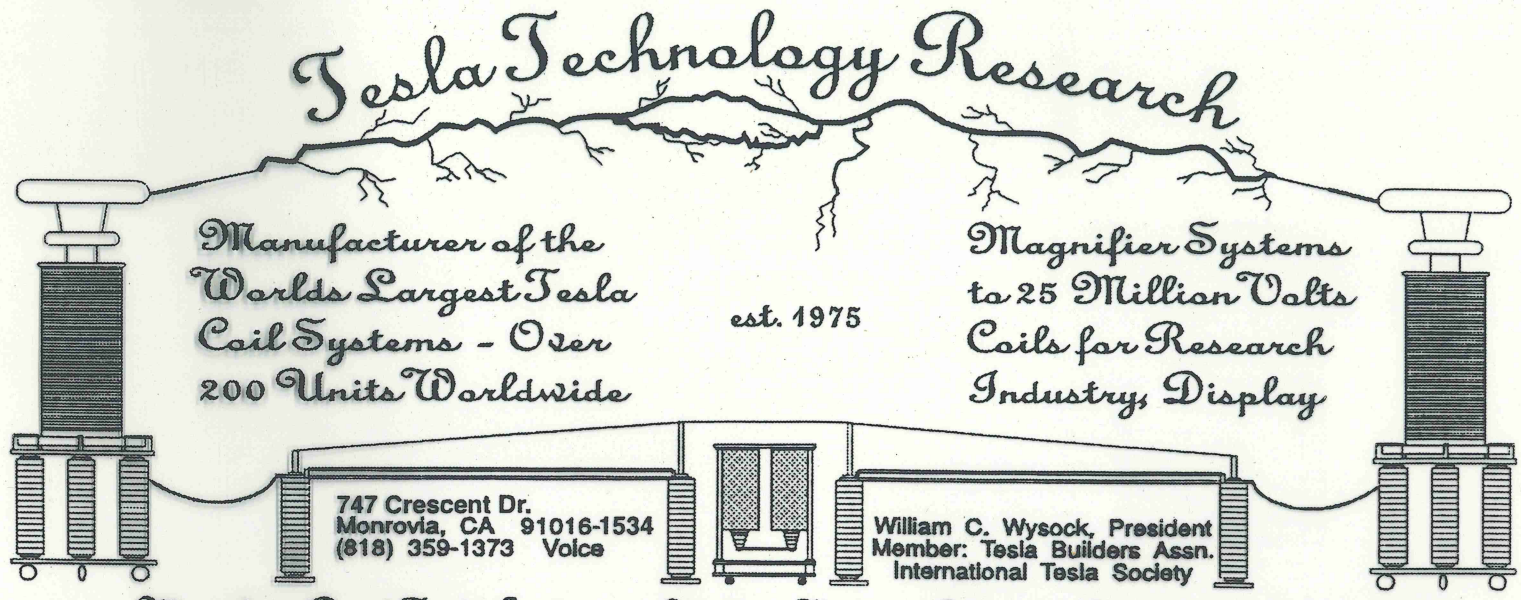
4) Anderson, L.I., "Nikola Tesla On His Work With Alternating Currents and Their Application to Wireless Telegraphy, Telephony, and Transmission of Power." Sun Publishing, Denver Colorado, 1992, PP. 48-179, Appendix II, PP. 169-179.

5) Wysock, W.C., "Modern Spark Gap Technology." Proceedings of the Extraordinary Science Symposium 1991, International Tesla Society, Inc., 1991.

ILLUSTRATIONS.

1) Model 14M Magnifier System, side view.
2) Model 14M Magnifier Primary and Secondary Coil Support Frame, plan view.
3) Model 14M Magnifier Primary and Secondary Coil Form, plan view.
4) Model 14M Secondary Coil Outer-most Helix Bobin Support, side view.
5) Model 14M Secondary Coil: 1st Secondary Winding, side view.
6) Model 14M Extra Coil Detail, side view.
7) Model 13M Magnifier System, side view.
8) Model 13M Magnifier Primary and Secondary Coil Assembly, side view.
9) Model 13M Magnifier Primary and Secondary Coil Form, bottom view
10) Model 13M Magnifier Primary and Secondary Coil Form, side view.
11) Model 13M Extra Coil Assembly, side view.
12) Model 13M Extra Coil Detail, side view.
13) Model 13M Secondary and Extra Coil Detail, side view.
14) Model 13M Schematic.
15) Model 13M Comparison notes vs.Colorado Springs Notes (CSN)
16) Model 13M Calculations.
17) Model 13M Power Spectral Density (PSD), HP-3561A Dynamic Signal Analyzer.
18) Model 13M Frequency Domain Measurements, HP-8563A Spectrum Analuzer.
19) Model 13M Time Domaim Measurements, Tek-468 Digital Storage Oscilloscope.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



1.) INTRODUCTION AND BACKGROUND: DESIGN OF MODEL 14M MAGNIFIER.
DESIGN OF MODEL 13M MAGNIFIER.

2.) ATTEMPTED EXHIBITION OF 13M AT COLORADO SPRINGS, JULY 22, 1994.

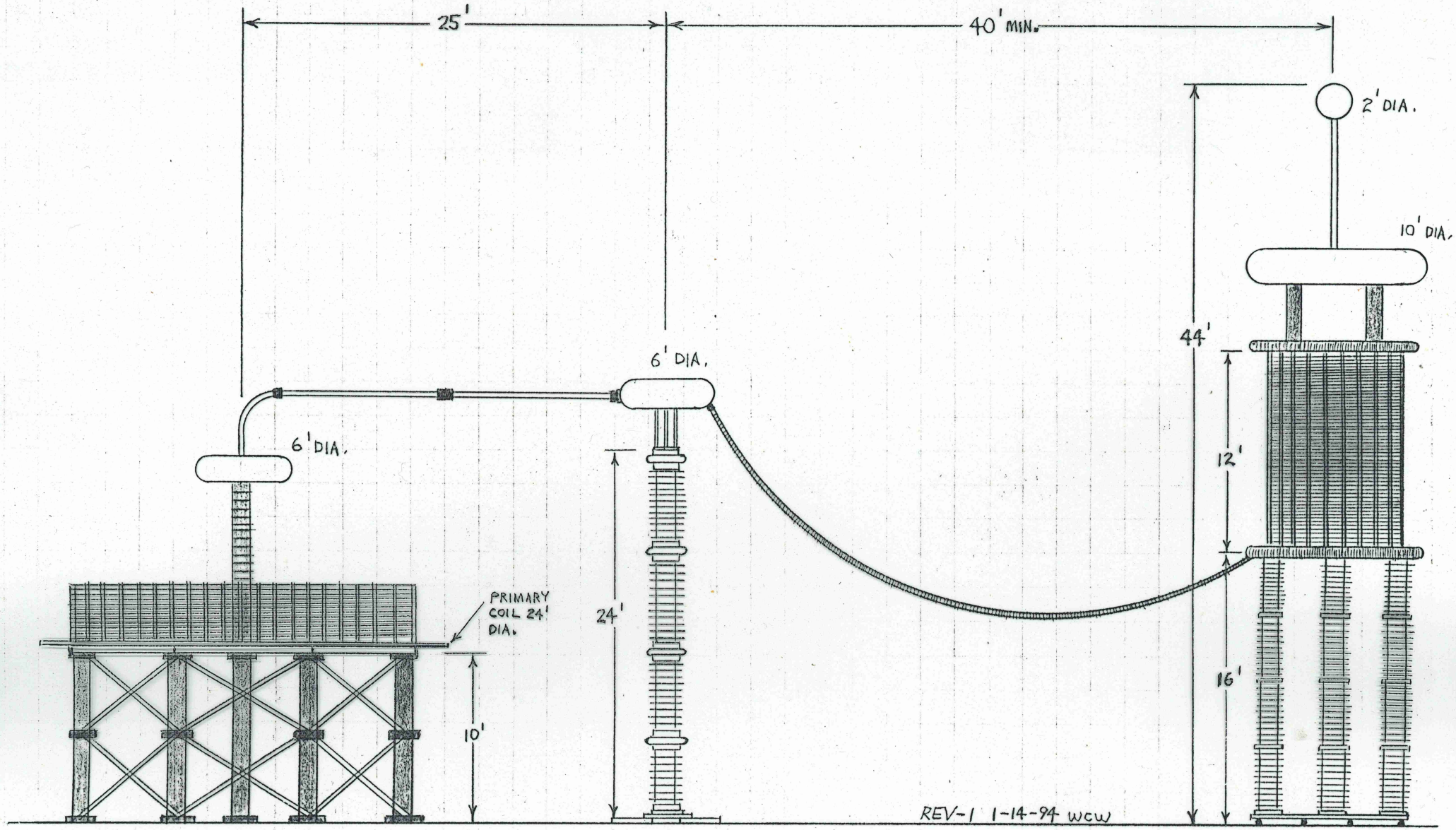
3.) FUTURE PLANS AND FURTHER MODIFICATIONS OF THE 13M MAGNIFER.

4.) QUESTIONS AND ANSWERS.

5.) EPILOG: A PERSONAL OPINION; WILL WE ALLOW HISTORY TO BE REWRITTEN?

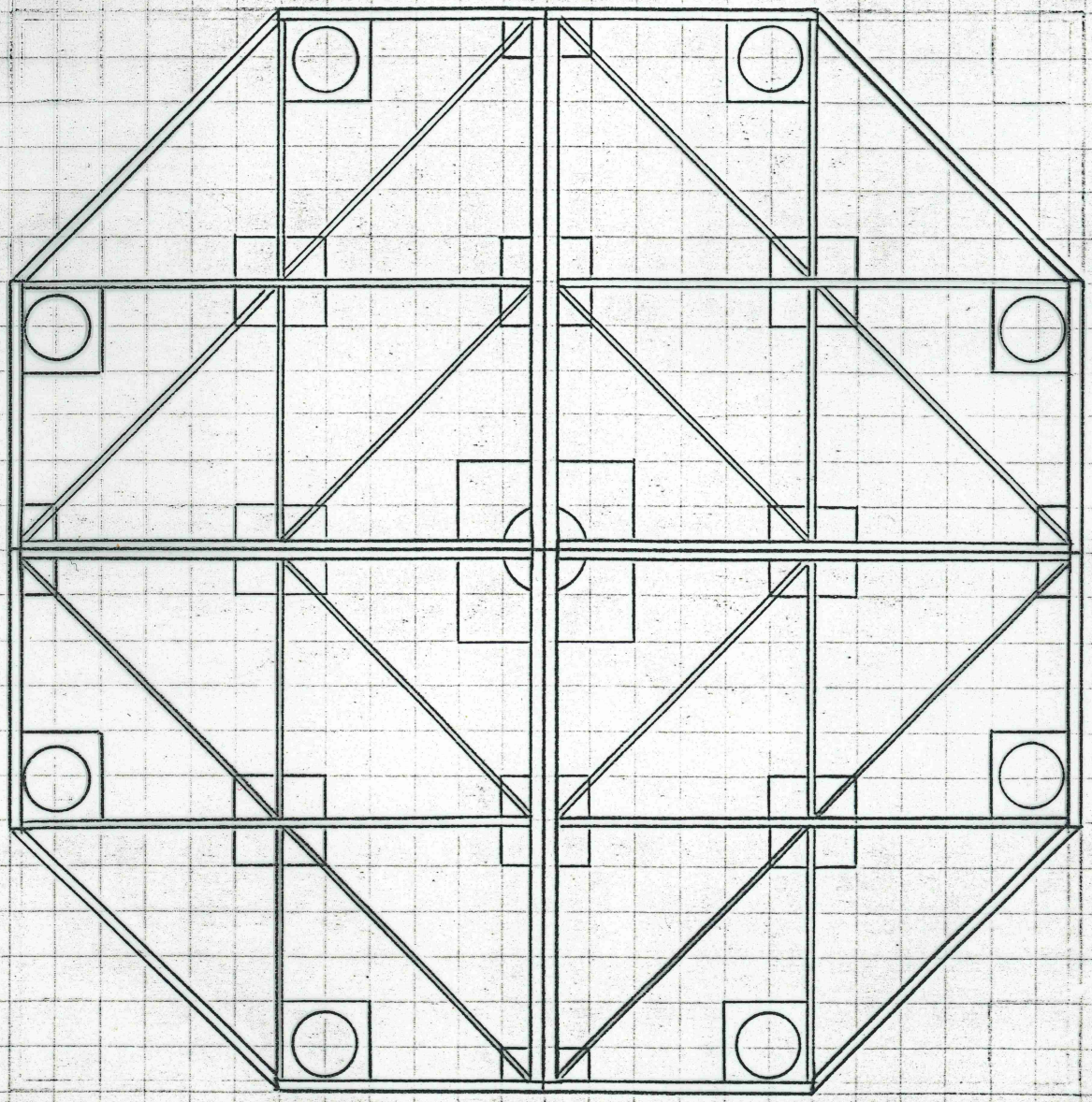
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH
MODEL 14
MAGNIFIER SYSTEM



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER SYSTEM
1ST STAGE SUPPORT FRAME

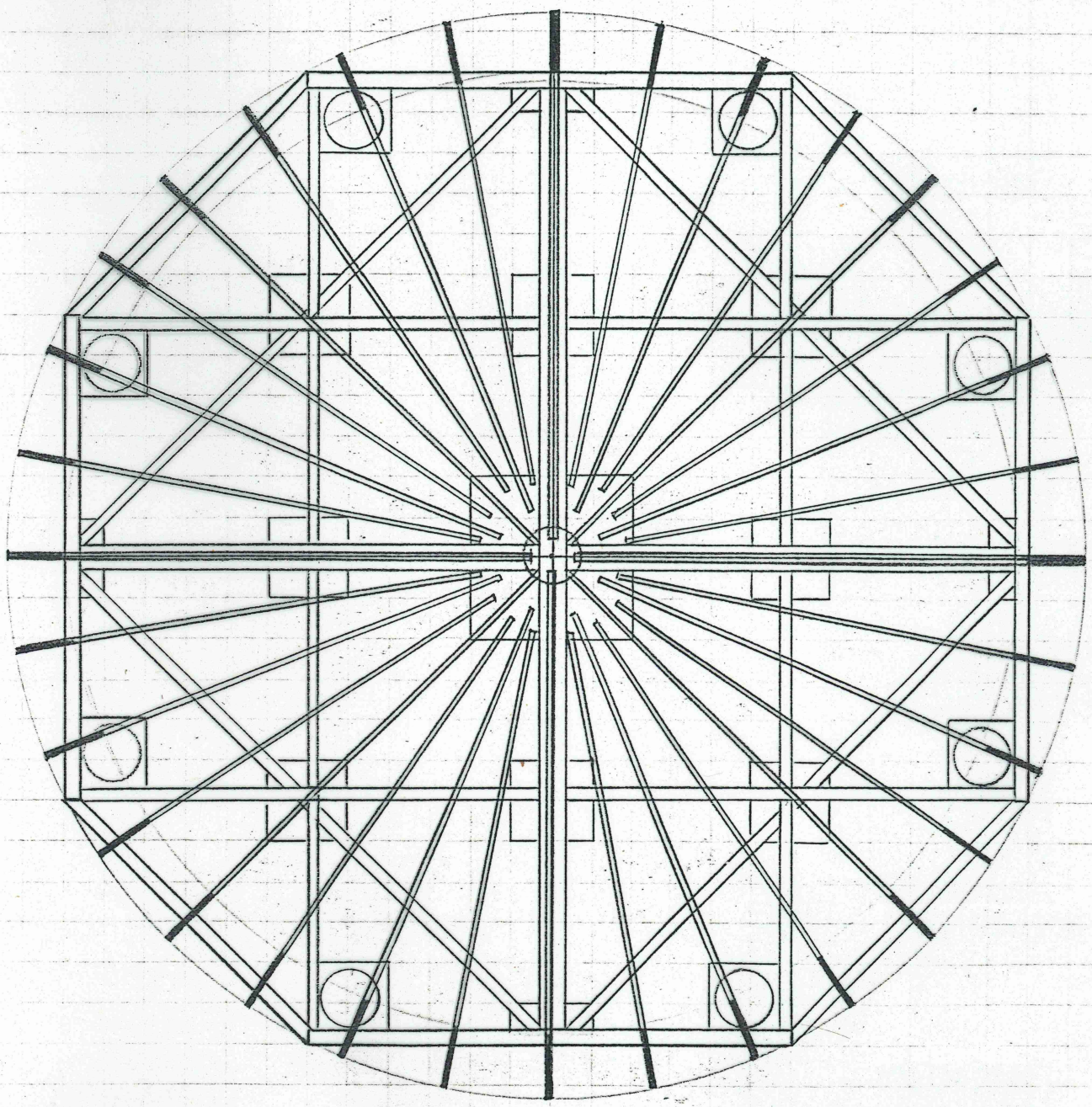


1/13/94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER SYSTEM

SECONDARY & PRIMARY COIL PLAN VIEW



0 1.25 2.5 5 10

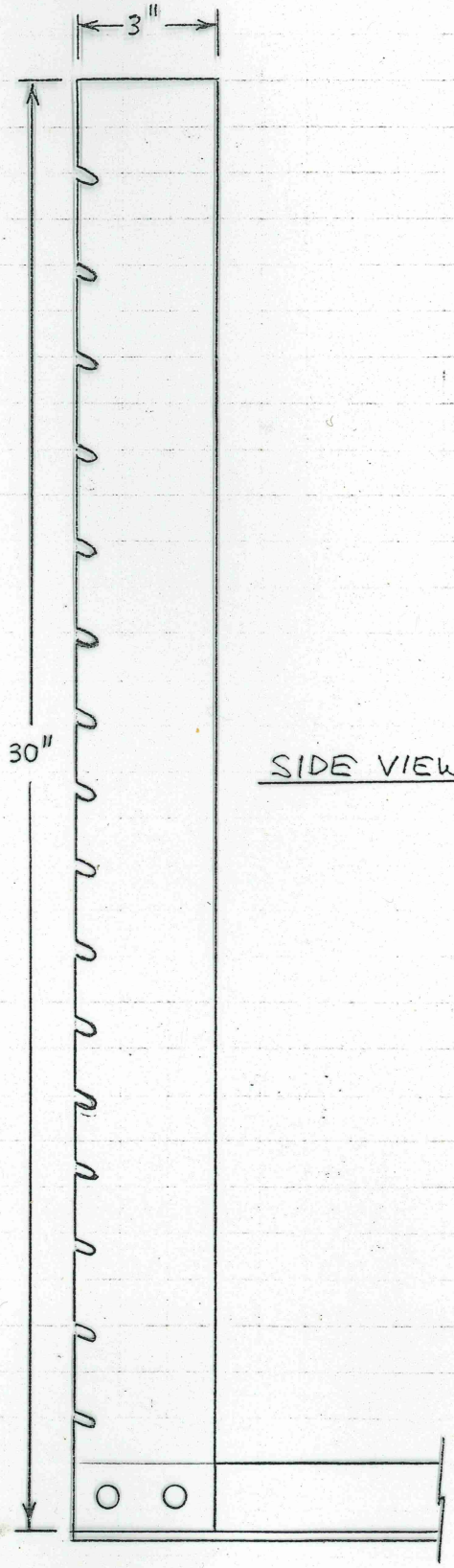
SCALE, FEET

32 PCS. TOTAL
16 PCS. 12' LONG
16 PCS. 10' LONG
352 LINEAR FEET TOTAL

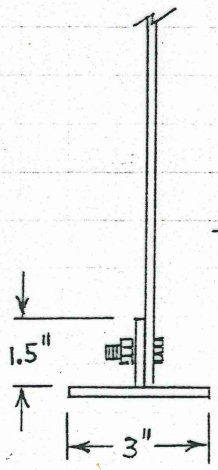
REV-1 1/13/94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

SECONDARY COIL
OUTER-MOST HELIX BOBIN SUPPORT
(TYP., 32 PLCS.)



SIDE VIEW

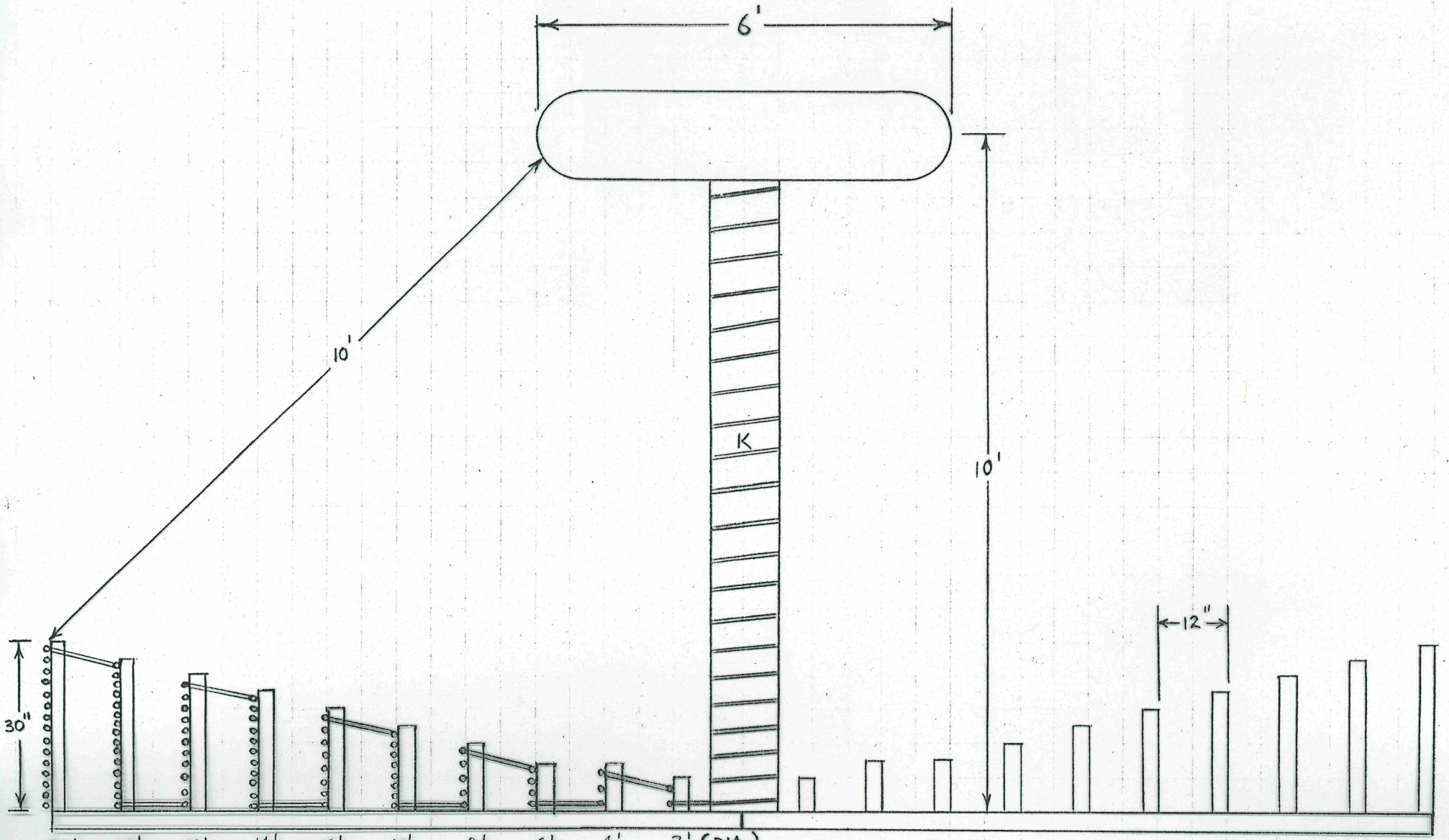


END VIEW DETAIL

1-12-94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 MAGNIFIER TESLA COIL: 1ST SECONDARY WINDING



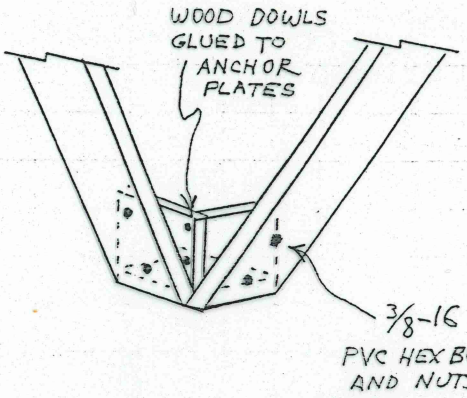
A	942.5
B	848.2
C	552.9
D	483.8
E	301.6
F	251.3
G	125.7
H	75.4
I	37.7
J	75.4

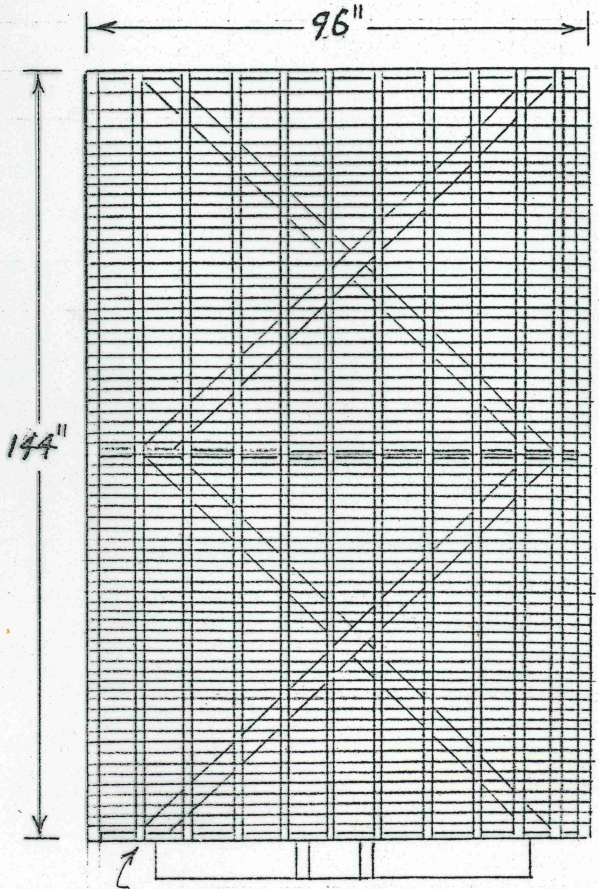
3,632' K= 63' TOTAL = 3,695'

1-12-94 WCW

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 14 TESLA COIL MAGNIFIER SYSTEM
EXTRA COIL DETAIL

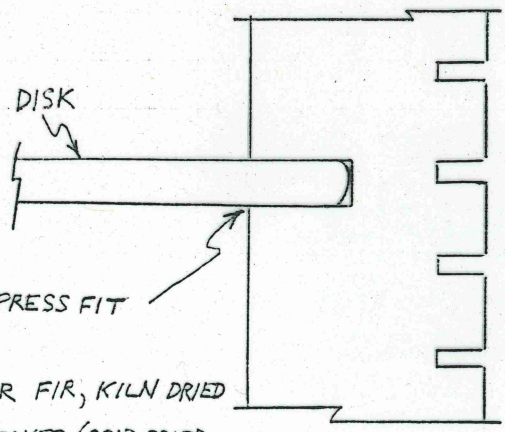




24 EA. VERTICAL SLATS, EVERY 7 7/8" ON CENTER

EXTRA COIL 100 TURNS = 2,513'
D = 96"

SECONDARY COIL 70 LAYERS = 3,695'
D = 20'



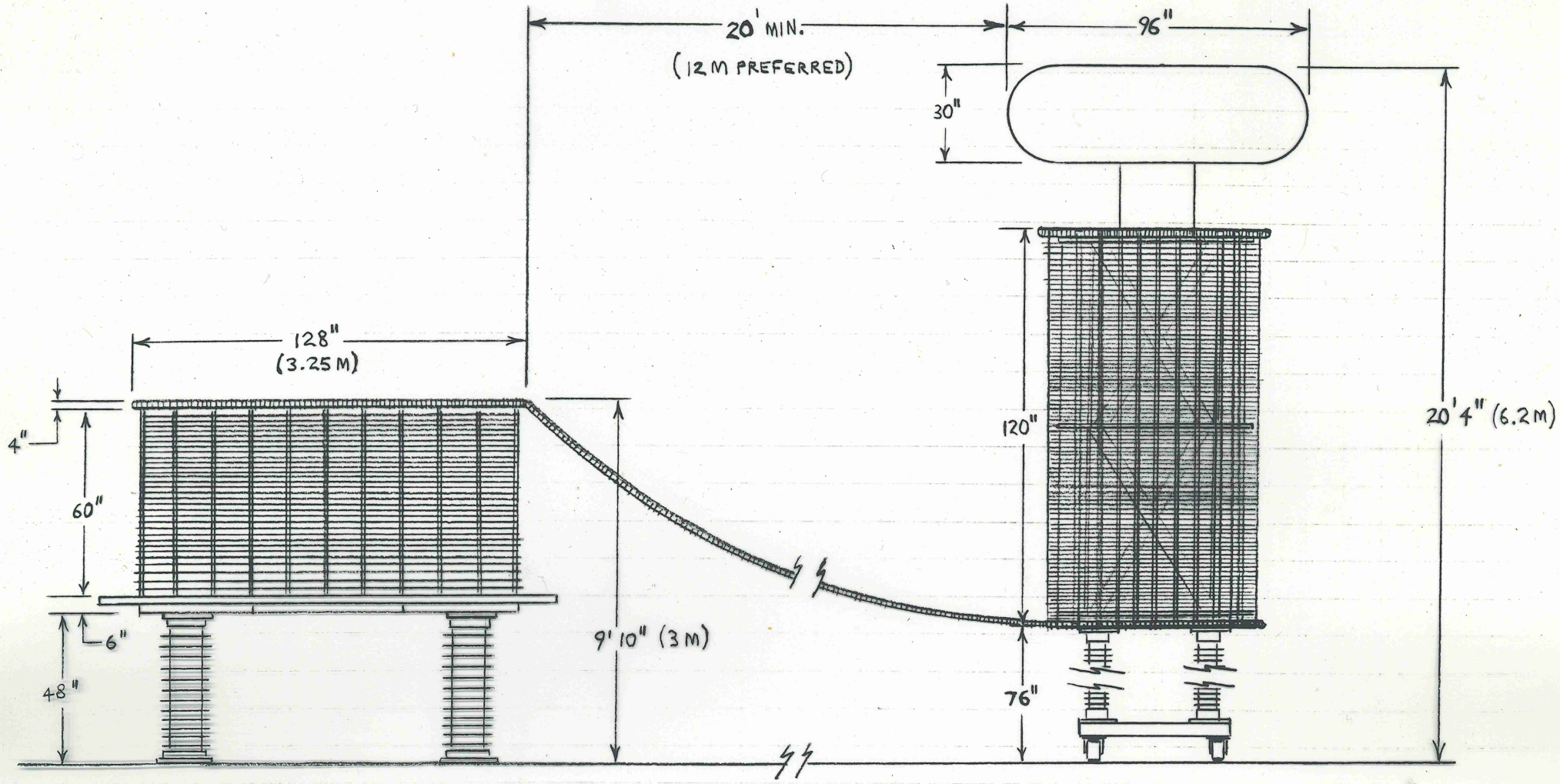
24 EA. 3/4" x 4" x 144" CLEAR FIR, KILN DRIED AND SOAKED/DRIP DRIED WITH THOMPSON'S WATER SEAL.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH

MODEL 13M MAGNIFIER
TESLA COIL SYSTEM
6+ MEGAVOLT

4-13-94



PRIMARY/SECONDARY

APPROX. 1,500 LBS.

MIN. 360° CLEARANCE FROM CENTER: 12'

0 4 8

SCALE, FEET

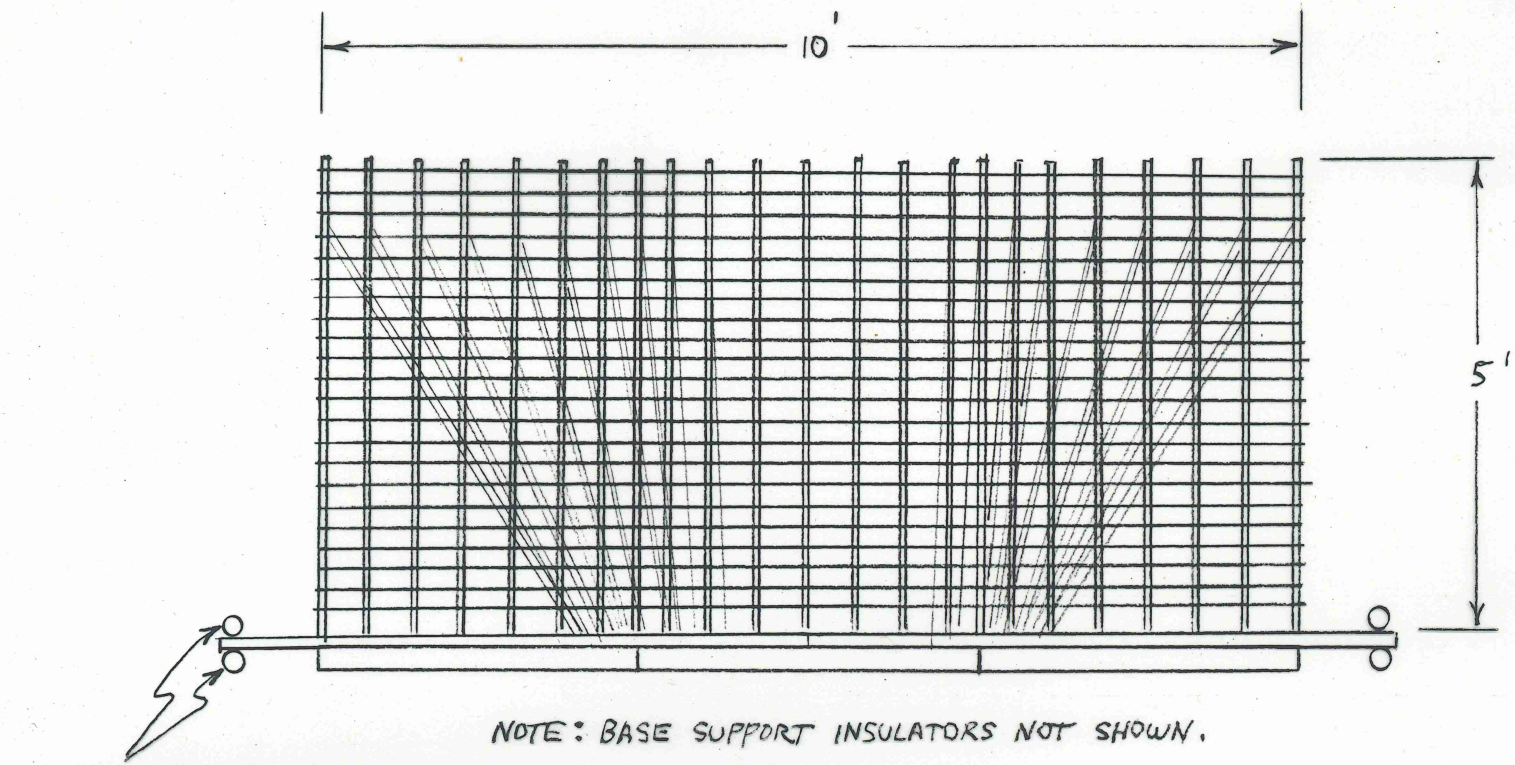
EXTRA COIL ASSY

APPROX. 1,200 LBS.

MIN. 360° CLEARANCE FROM CENTER: 40'

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

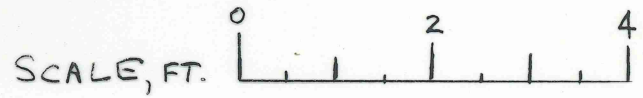
TESLA TECHNOLOGY RESEARCH
MODEL 13 M
MAGNIFIER SYSTEM
PRIMARY / SECONDARY
COIL FORM



30 TURNS,
2" SPACING
942' #4 AWG

NOTE: BASE SUPPORT INSULATORS NOT SHOWN.

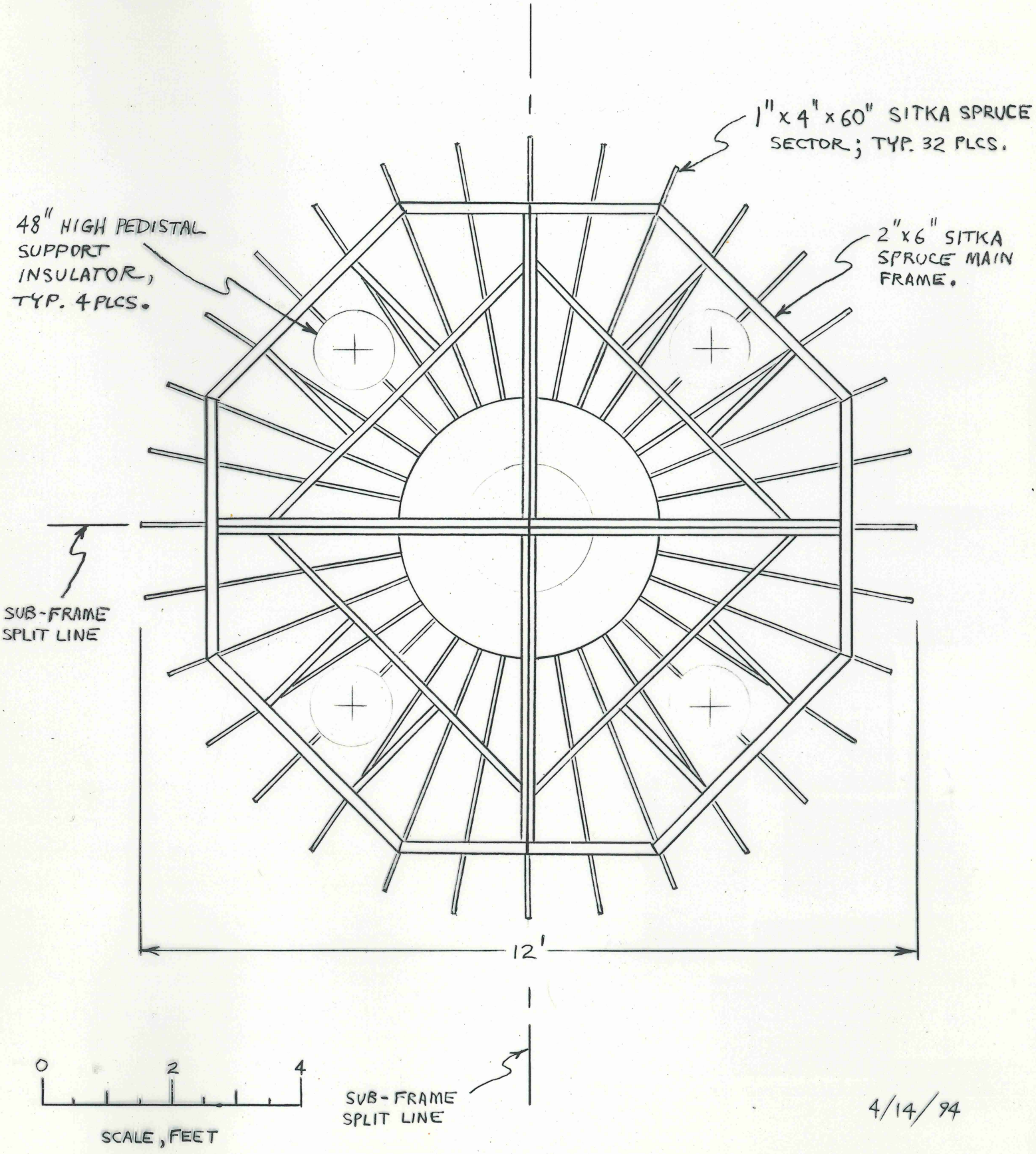
USE RYAN-HERCO
P/N 0965-018
ON EXTRA COIL.



4/13/94

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER
PRIMARY/SECONDARY COIL FORM, BOTTOM VIEW

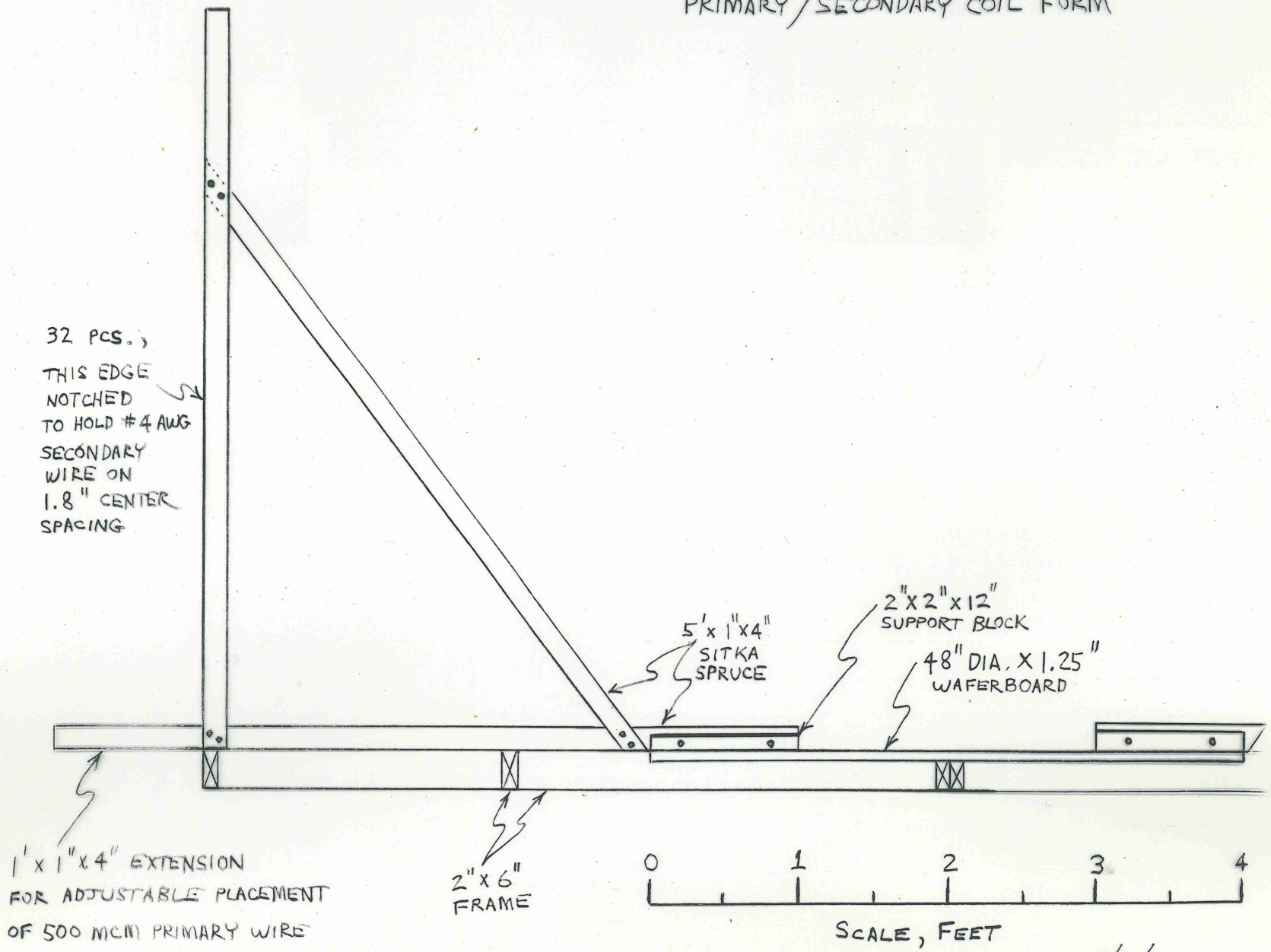


4/14/94

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

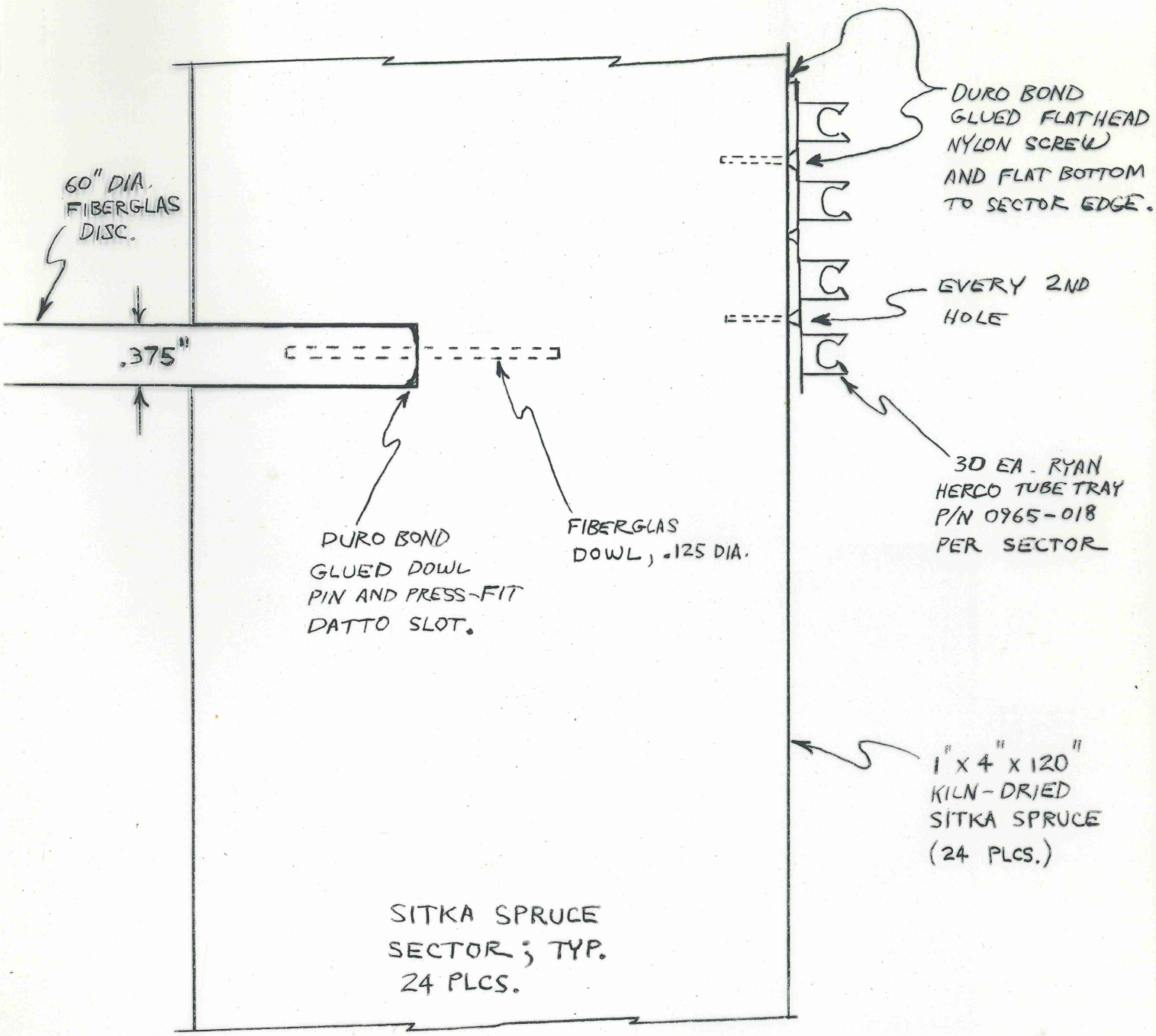
TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER

CUT-AWAY VIEW OF
PRIMARY/SECONDARY COIL FORM



4/13/94

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER
EXTRA COIL ASSY. DETAIL

ATTACHMENT B

0 1 2 3 4

SCALE, INCHES

4-19-94

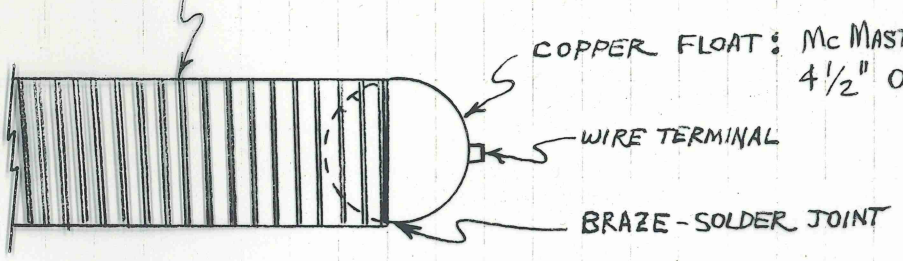
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

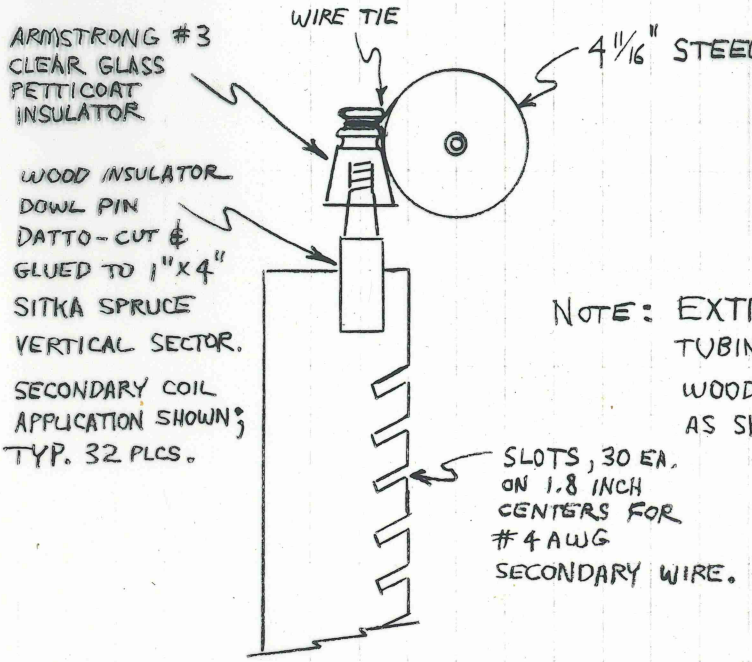
TESLA TECHNOLOGY RESEARCH

MODEL 13M MAGNIFIER TESLA COIL SYSTEM

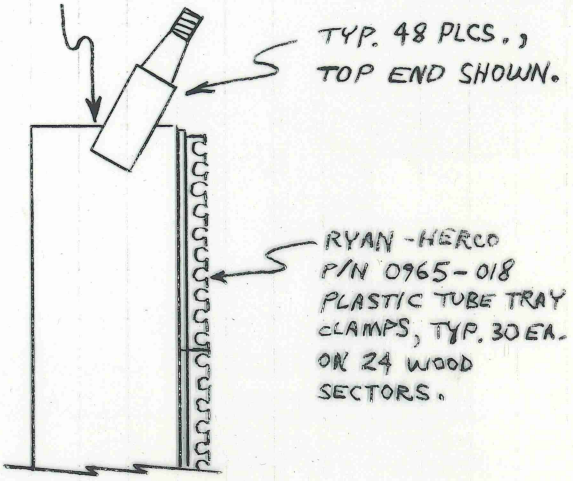
SECONDARY & EXTRA COIL CORONA TOROID RINGS & TRANSMISSION LINE

GALVANIZED STEEL STANDARD WEIGHT THIN WALL TUBING:
Mc MASTER-CARR # 5262K45 4 11/16" O.D. x 4 1/2" I.D.





NOTE: EXTRA COIL HAS 2 CORONA TOROID TUBING RINGS - TOP AND BOTTOM.
WOOD INSULATOR PIN IS CANTED OUTWARD, AS SHOWN BELOW.



MATERIALS LIST:

SECONDARY COIL - 32 #3 WOOD DOWL PINS
32 #3 ARMSTRONG INSULATORS
33 FEET CORRUGATED TUBING
2 4 1/2" DIA. COPPER SPHERES

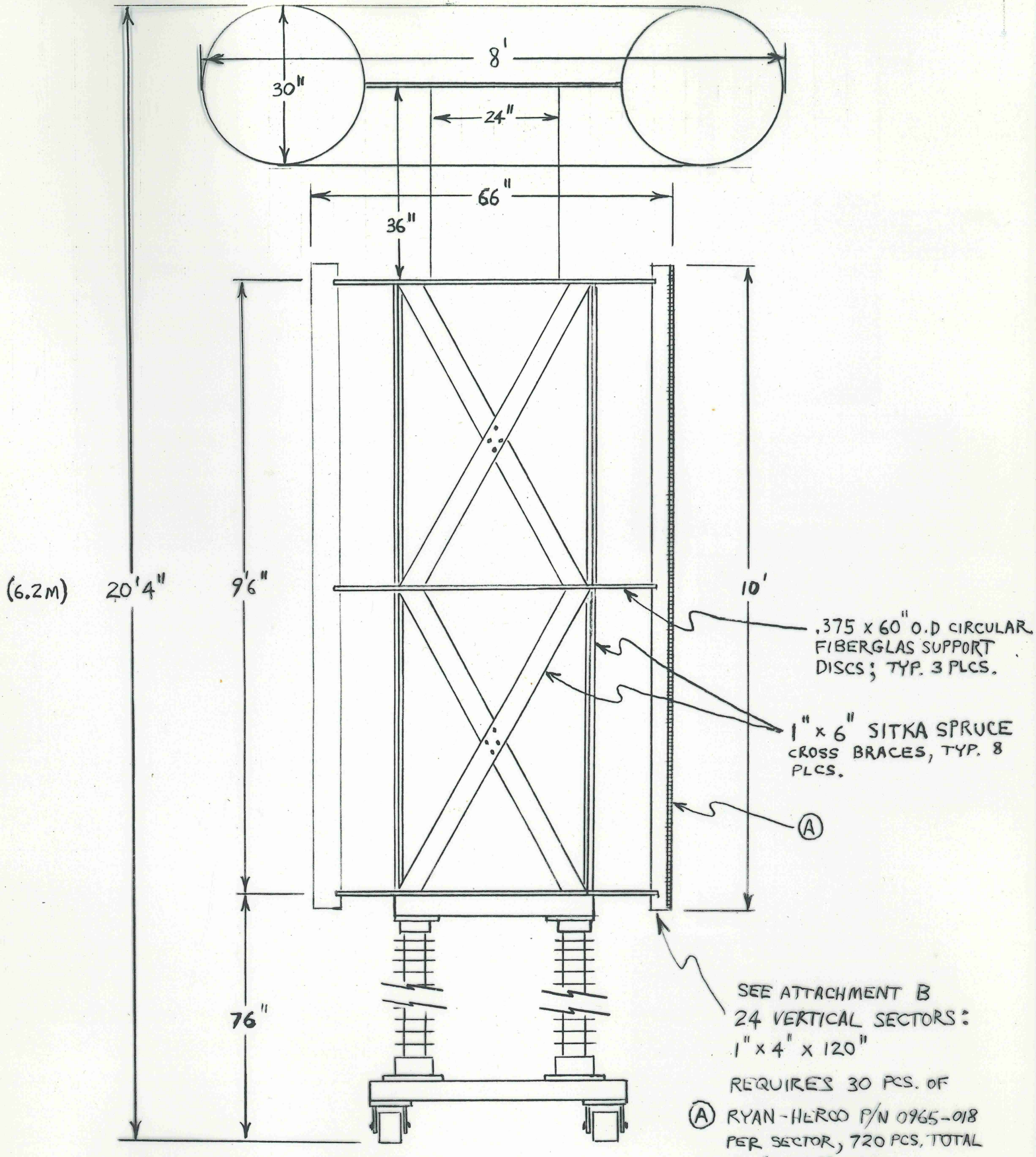
EXTRA COIL - 48 #3 WOOD DOWL PINS
48 #3 ARMSTRONG INSULATORS
37 FEET CORRUGATED TUBING
4 4 1/2" DIA. COPPER SPHERES

TRANSMISSION LINE - 2 4 1/2" DIA. COPPER SPHERES
25 FEET CORRUGATED TUBING

TOTALS: TUBING - 95 FEET
WOOD DOWLS - 80
INSULATORS - 80
COPPER SPHERES - 8

4-21-94

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



TESLA TECHNOLOGY RESEARCH
MODEL 13 M MAGNFIER
EXTRA COIL ASSEMBLY

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

T_1 = 100 KVA (CONTINUOUS) 36 KV OUT, VARIABLE.

L_{1A}, L_{1B} = 500,000 MCM, 452" LENGTH EA., 144" DIA., 2" HELIX SPACING, CENTER TO CENTER, 1 TURN BIFILAR.

L_2 = #4 AWG, 11,304" LENGTH, 120" DIA., 1.8" HELIX SPACING, 30 TURNS, 60" HIGH (COIL ONLY).

L_3 = #8 AWG, 31,104" LENGTH, 66" DIA., 0.8" HELIX SPACING, 150 TURNS, 120" HIGH (COIL ONLY).

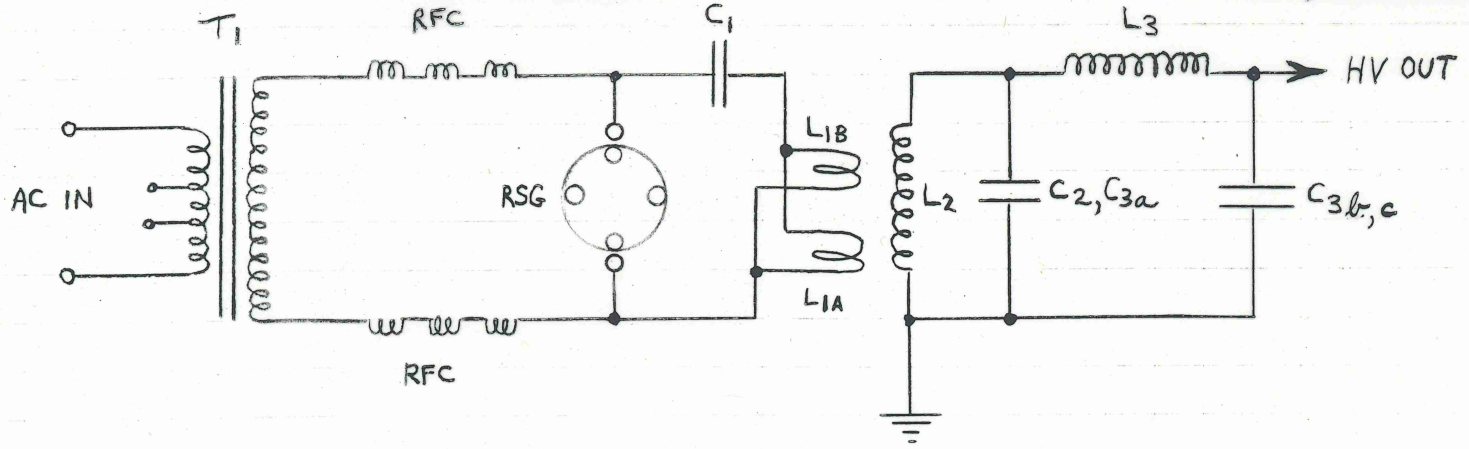
C_1 = ADJUSTABLE, 0.04 TO 0.26 MFD @ 50 KV AC RMS; TARGET VALUE; 0.16 MFD.

C_2 = SEC. COIL TOROID CORONA TOP RING, 1 TURN NON-SHORTING, 4 11/16" DIA. TUBE, 124" DIA. X 118" HIGH ABOVE GROUND.

C_{3a} = EXTRA COIL TOROID CORONA BOTTOM RING, 1 TURN NON-SHORTING, 4 11/16" DIA. TUBE, 71" DIA. X 45" HIGH ABOVE GROUND.

C_{3b} = EXTRA COIL TOROID CORONA TOP RING, 1 TURN NON-SHORTING, 4 11/16" DIA. TUBE, 71" DIA. X 165" HIGH ABOVE GROUND.

C_{3c} = EXTRA COIL TOROID DISCHARGE ELECTRODE, 96" DIA. X 30" CROSS SECTION, EQUATOR 195" HIGH ABOVE GROUND.



RSG = 240 P.P.S., DWELL = 25 μSEC.

TESLA TECHNOLOGY RESEARCH

4-22-94

MODEL 13M MAGNIFIER

TESLA COIL SYSTEM

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

COMPARISON NOTES

4/18/94

CSN

SEC. = 49.25' = 591"
SEC. CIRCUM = 1,856.681259"
17 TURNS = 31,564" = 2,630'

EX. COIL = 8'3" = 99"
EX COIL CIRCUM. = 311.017673"
100 TURNS = 31,102" = 2,592'

MODEL 13M

SEC. = 10' = 120"
SEC. CIRCUM. = 376.991119"
30 TURNS = 11,300" = 942'

EX. COIL = 5'6" = 66"
EX. COIL CIRCUM. = 207.345115"
150 TURNS = 31,102" = 2,592'

13M SEC = 942'
CSN SEC. = 2630' = 2.8:1 RATIO

13M EX. COIL = 2,592'
CSN EX. COIL = 2,592' = 1:1 RATIO

SECONDARIES

13M CIRCUM. = 31.42'
CSN CIRCUM. = 154.72'

4.92 : 1 RATIO

13M SEC. = L_{LOW} C_{HIGH}
CSN SEC. = L_{HIGH} C_{LOW}

13M SEC. C_{HIGH} ∴ 2.8X CSN SEC. C_{LOW}

PRIMARIES

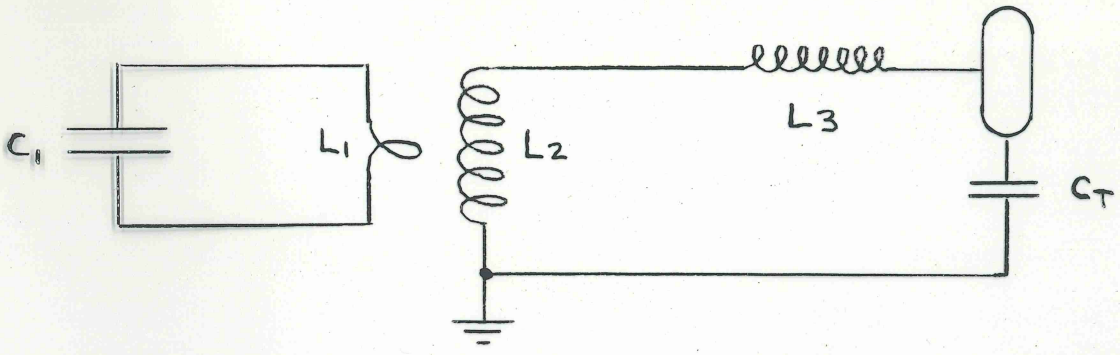
CSN = 27x #9AWG = 353,430 CIR. MIL
13M = 500,000 CIR. MIL

CSN = COLORADO SPRINGS NOTES

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

TESLA TECHNOLOGY RESEARCH

MODEL 13M MAGNIFIER
TESLA COIL SYSTEM



$C_1 = 0.275\ \mu f$

L_1 = 2 EA. SINGLE PARALLEL 500 MCM TURNS.

L_2 = 30 TURNS #4 AWG.

L_3 = 150 TURNS #8 AWG.

L (TOTAL CALCULATED) = 13.5 mH

$C_T = \frac{1}{(2\pi f)^2 L} \cong 293\ pF$

$f \cong 80$ KHz (FROM POWER SPECTRAL DESITY MEASUREMENTS) PSD.

ARCHING VOLTAGE FOR A 40 FOOT R.F. SPARK:

$$V = [40 \times 12]_{in.} \times 8700_{[1]} \frac{V}{in.} = 4.2\ MV$$

THE ENERGY (W) IN $C_T = \frac{1}{2} V^2 C_T = 2555$ VA

SINCE TOTEL ENERGY FROM SOURCE = 100 KVA, THE NUMBER OF SPARKS/SECOND =

$$\frac{100\ KVA}{2555} = 39$$ (ASSUMING 100% EFFICIENCY).

TO FIND THE AVERAGE SPARK LENGTH ASSUMING 2 SPARKS/CYCLE AND 100 KVA AVAILABLE (I.E. 120 SPARKS/SECOND): ENERGY AVAILABLE = $\frac{100KVA}{120} = 833$ VA.

SINCE $W = \frac{1}{2} V^2 C$, $V = \sqrt{\frac{2W}{C}} = 2.4$ MV.

THEREFORE LENGTH = $\frac{2.4\ MV}{8700} = 274$ in. = 22.8 ft.

11-20-95

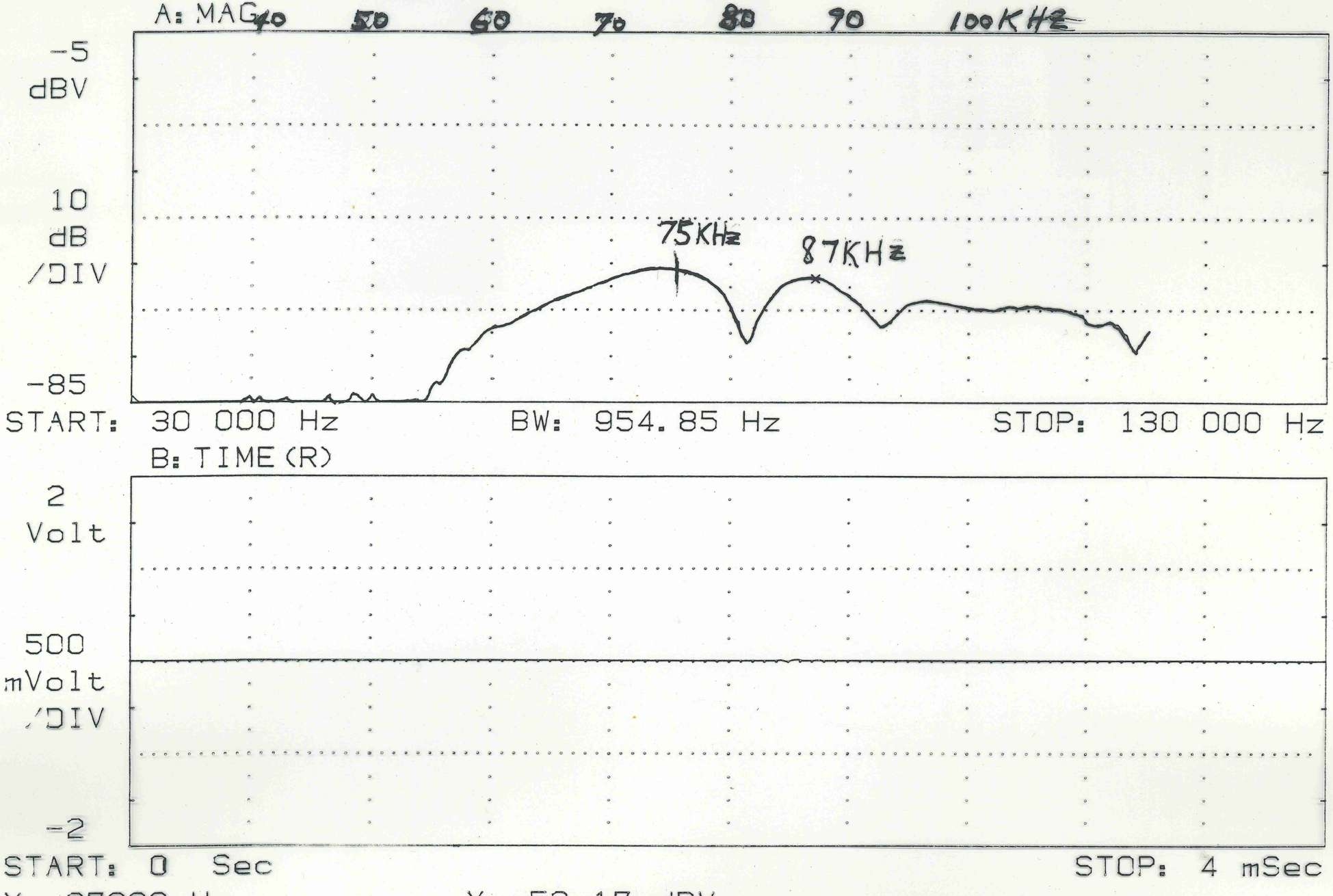
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

EQUIPMENT
HP MODEL 3561A
DYNAMIC SIGNAL ANALYZER

ANTENNA PREAMP
STODART 94592-1
WITH 48" ROD ANTENNA

LAST RUN 9:40 PM

RANGE: -5 dBV STATUS: PAUSED



X: 87000 Hz Y: -58.17 dBV

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

8-19-95

TESLA TECHNOLOGY RESEARCH
MODEL 13M MAGNIFIER TESLA COIL

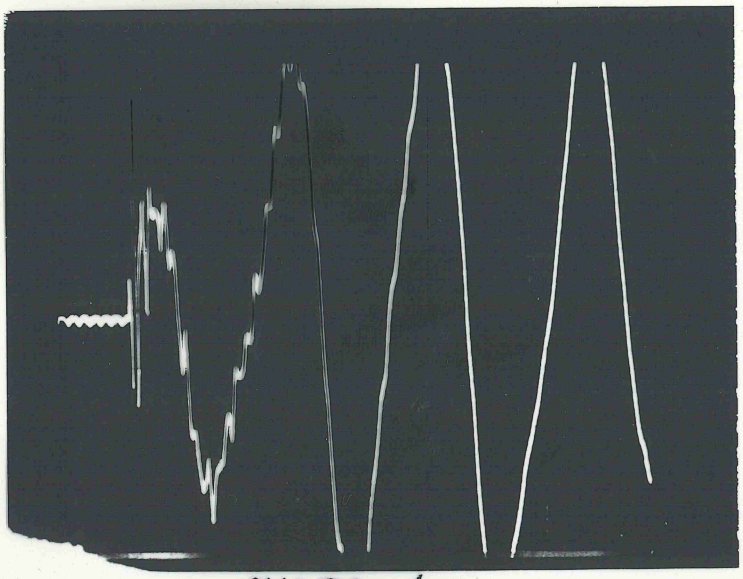


PHOTO 1

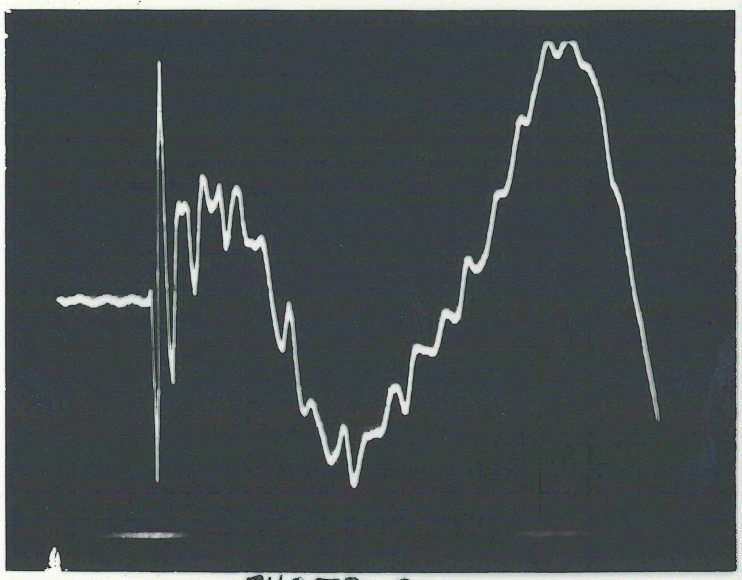


PHOTO 2

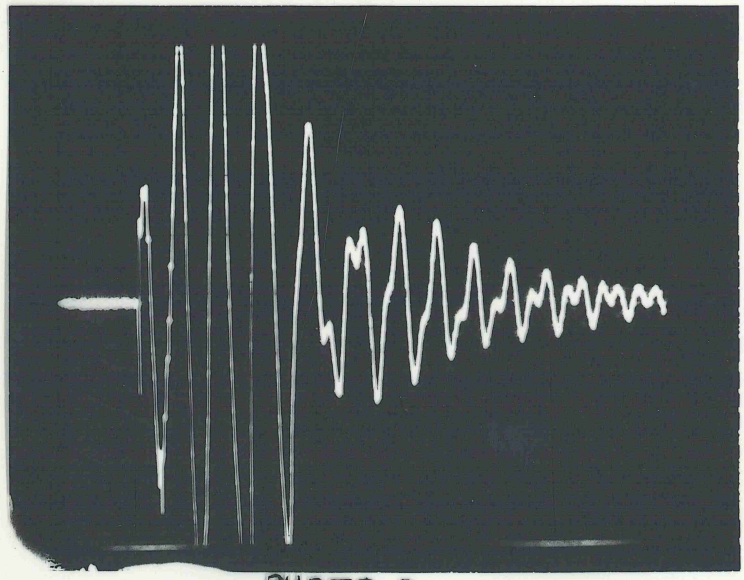
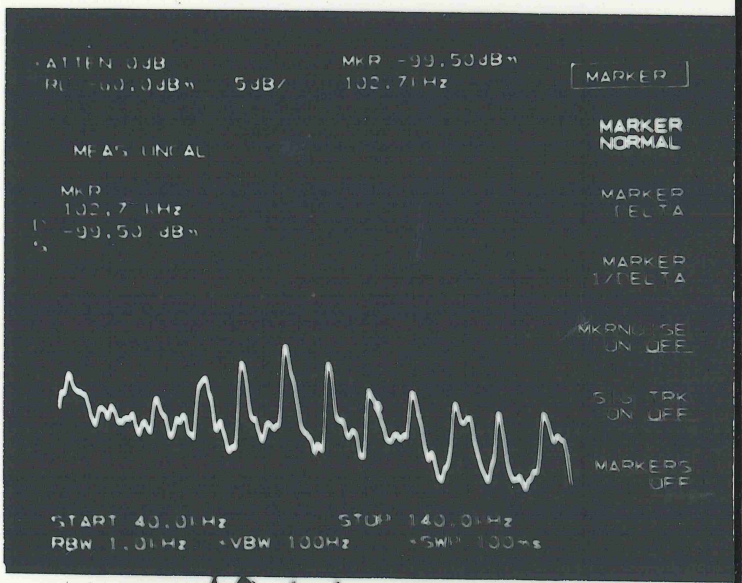


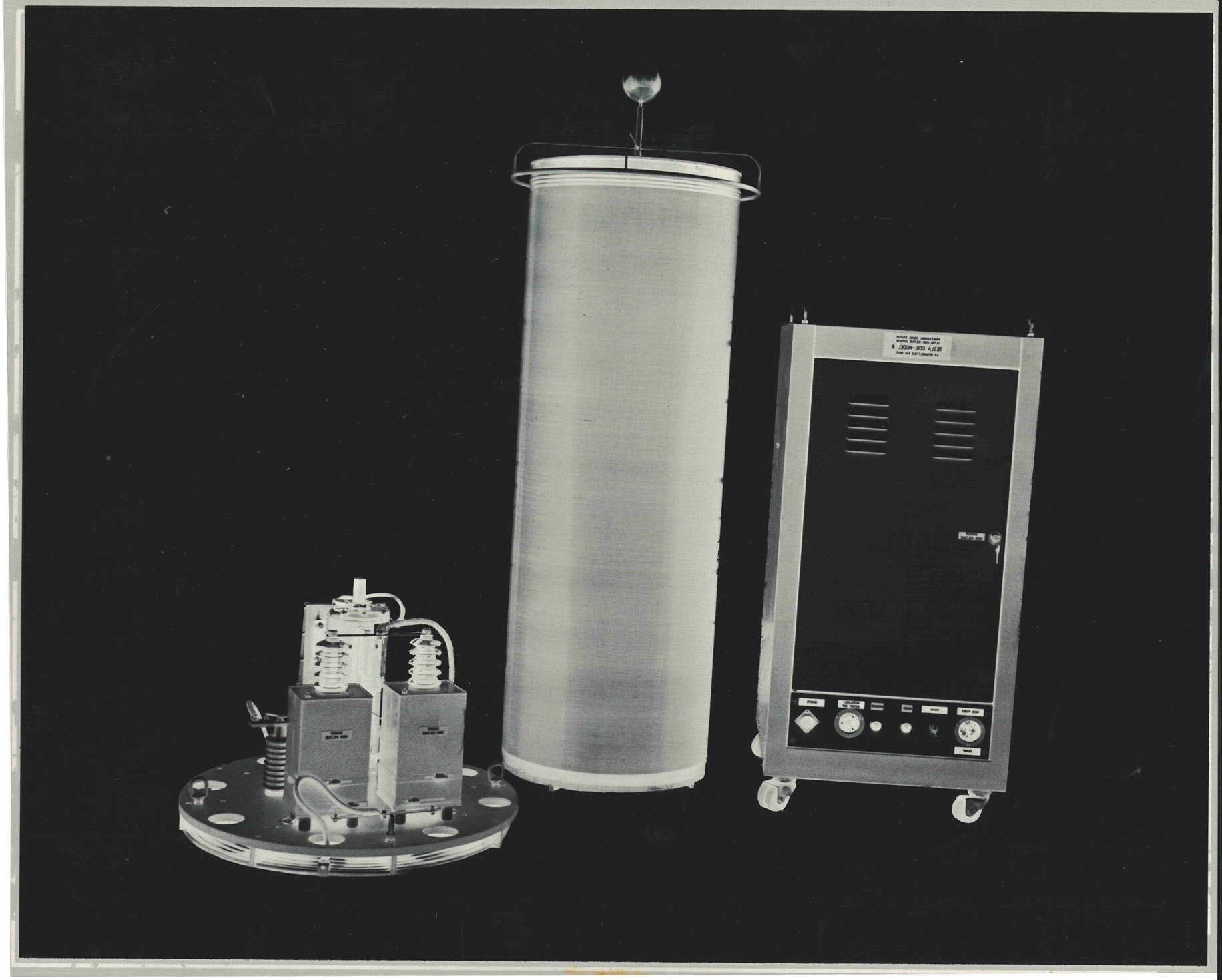
PHOTO 3



70KHz ↑ 75 ↑ 84 ↑ 92 KHz PHOTO 4

8-19-95

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP



PROFESSIONAL SOUND SYSTEMS PHOTO E

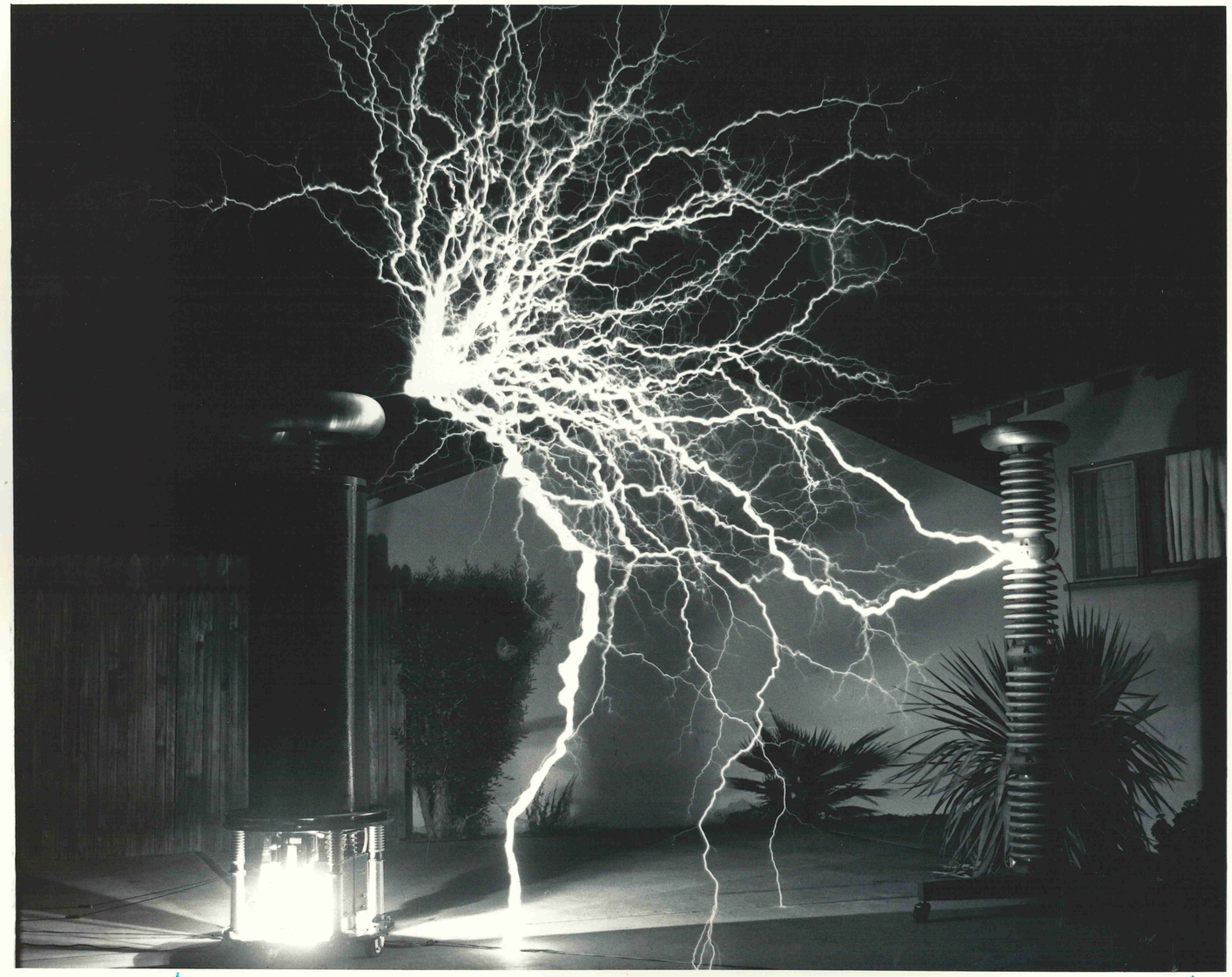
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

97%
H/T 100%s
neg only

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

Page 6 96½%

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

SUPER MODEL 9 TESLA COIL
FEB '82

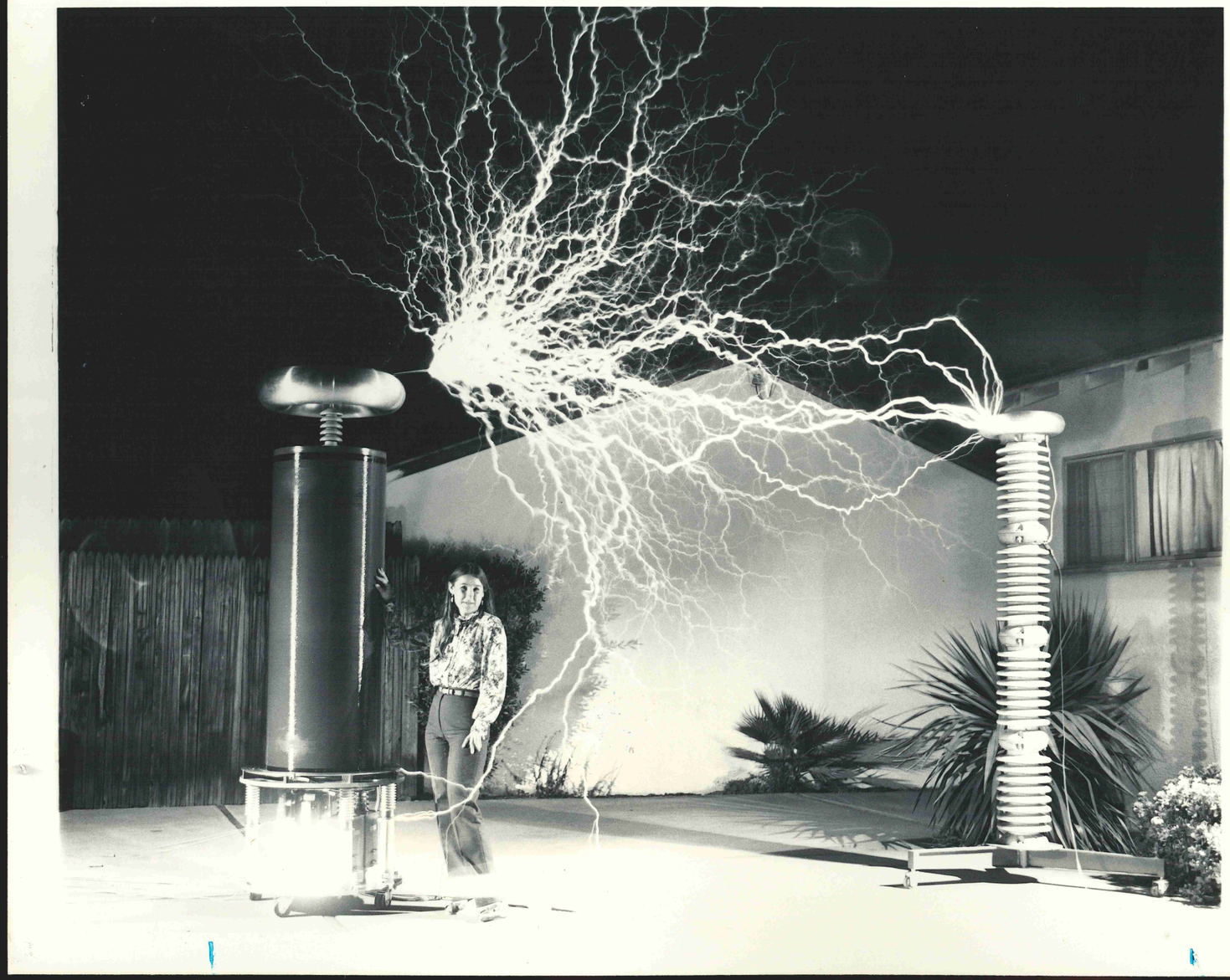
PHOTO [redacted] 1F

SHOOT DOWN 50%

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

7½% (A) pg 8

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

~~DELUX~~

SUPER MODEL 9 COIL

SHOOT DOWN 50%

FEB '82

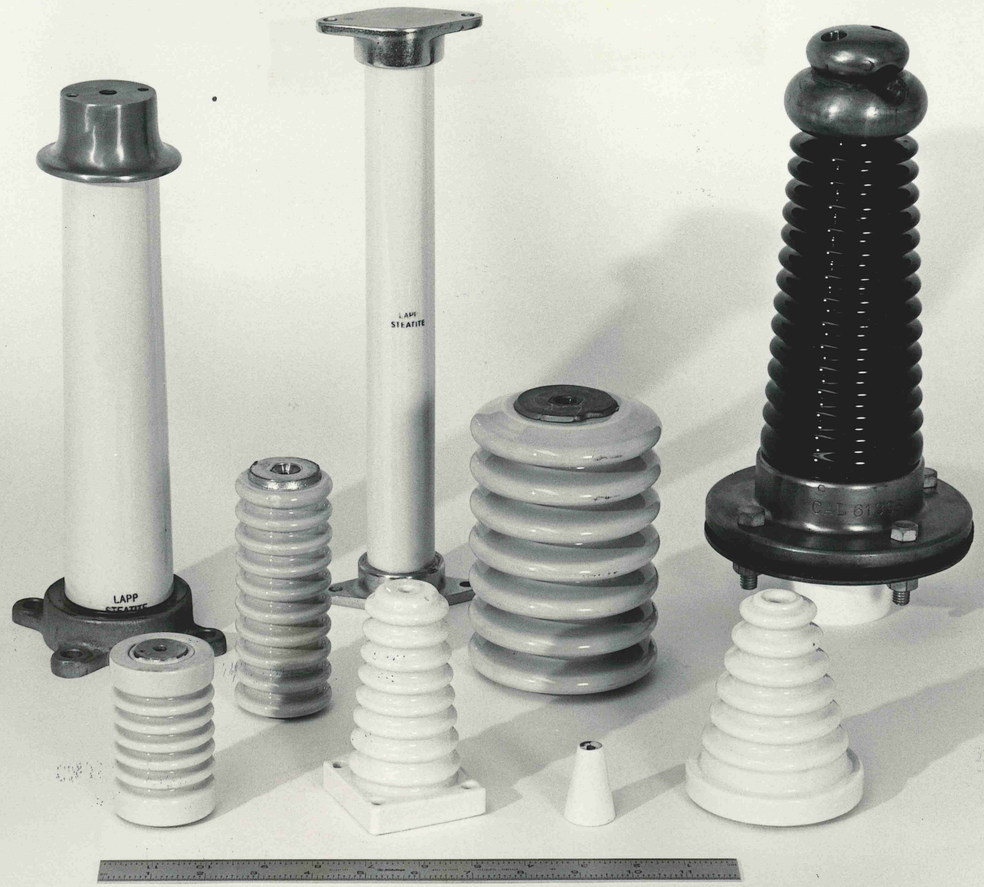
PHOTO 1G

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

71½% (B) pg 8

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP



PROFESSIONAL SOUND SYSTEMS PHOTO G

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

66%
IR/T 100%s
neg only

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

66% pg 7 (6)

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP



PROFESSIONAL SOUND SYSTEMS PHOTO F

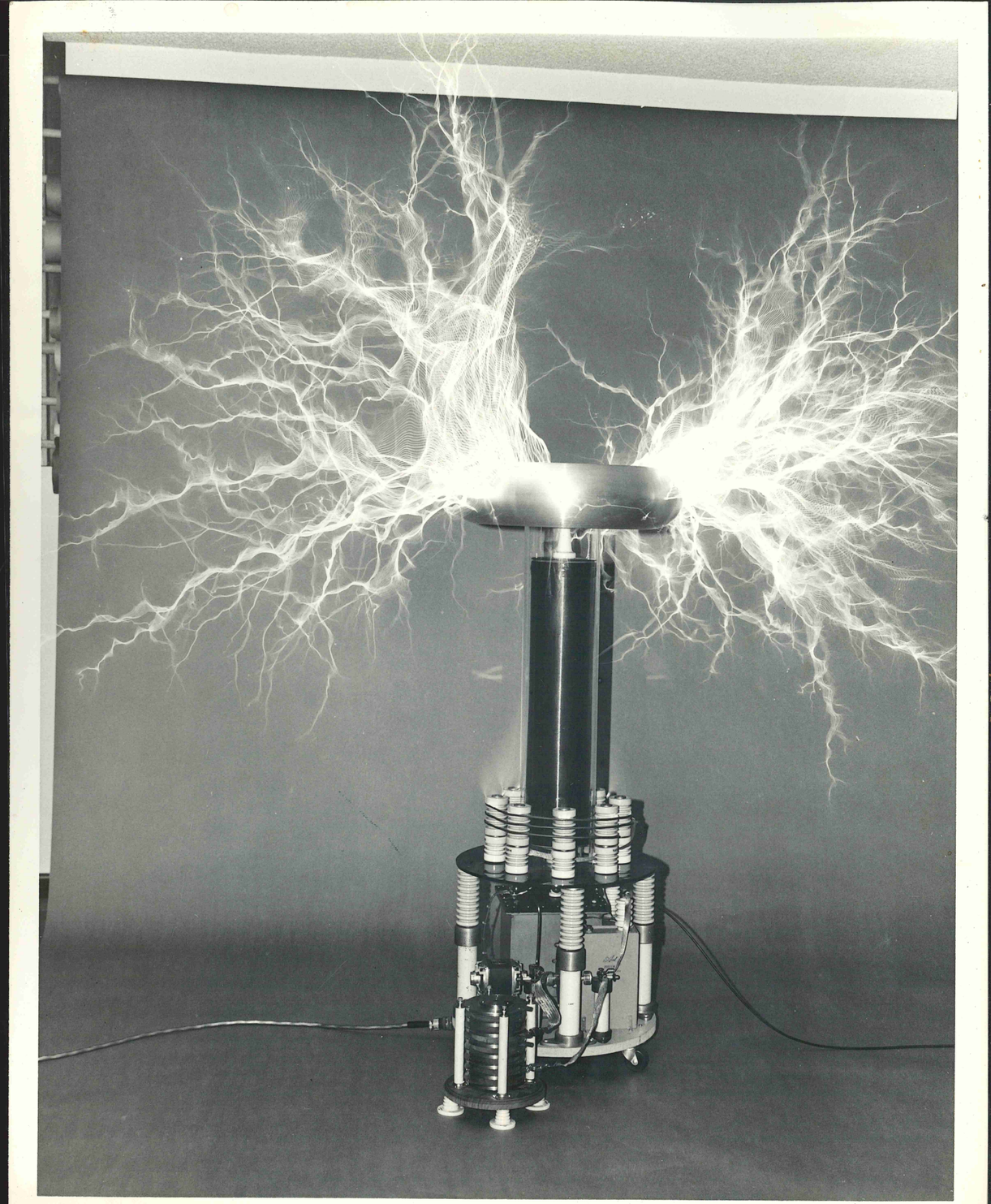
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

~~H/O~~ 60%
H/T 100 1/5
neg only

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

(F) 60% pg 7

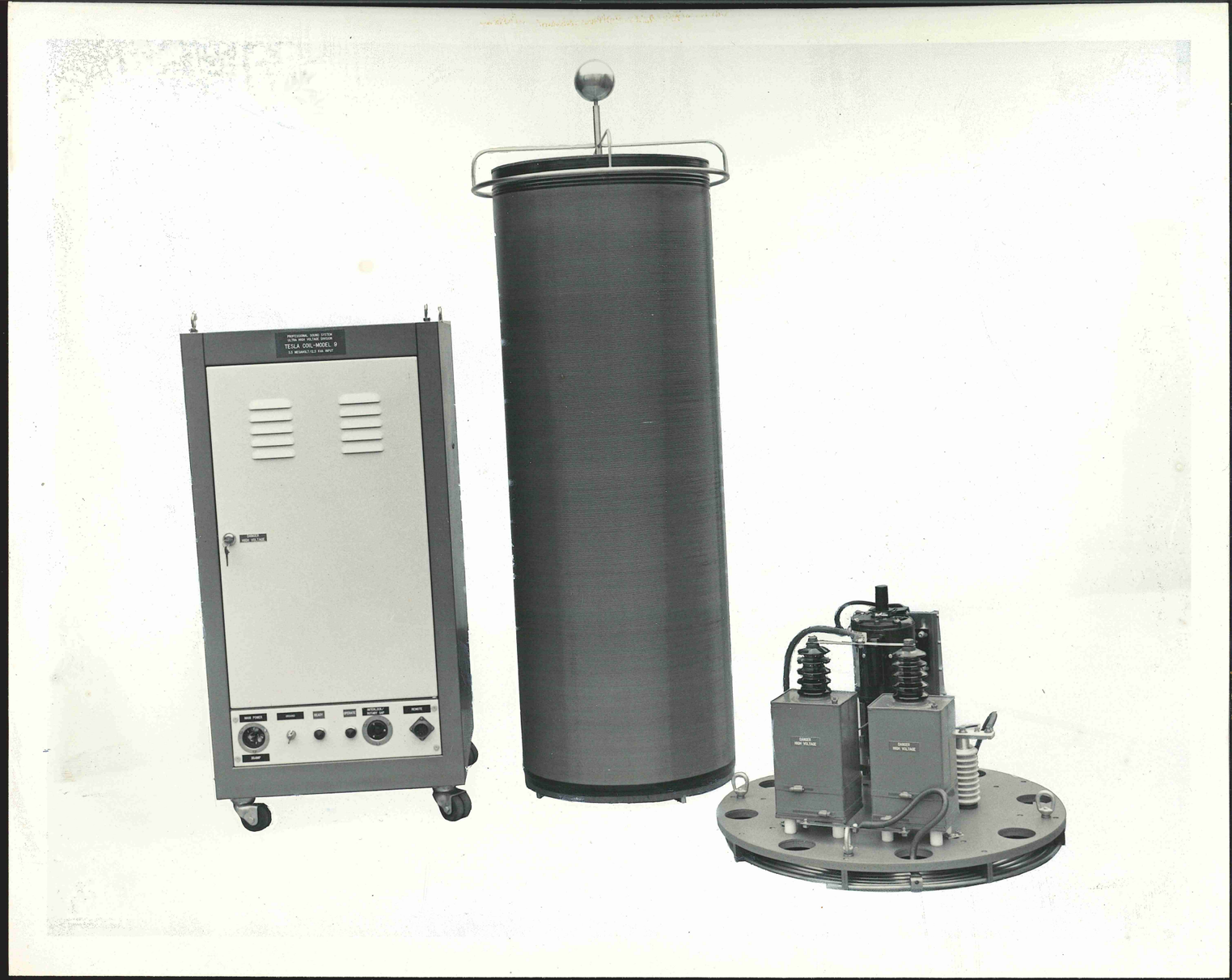
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

① 118%

+

① 100% ←

pg 11

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PAGE 1

PHOTO 1C

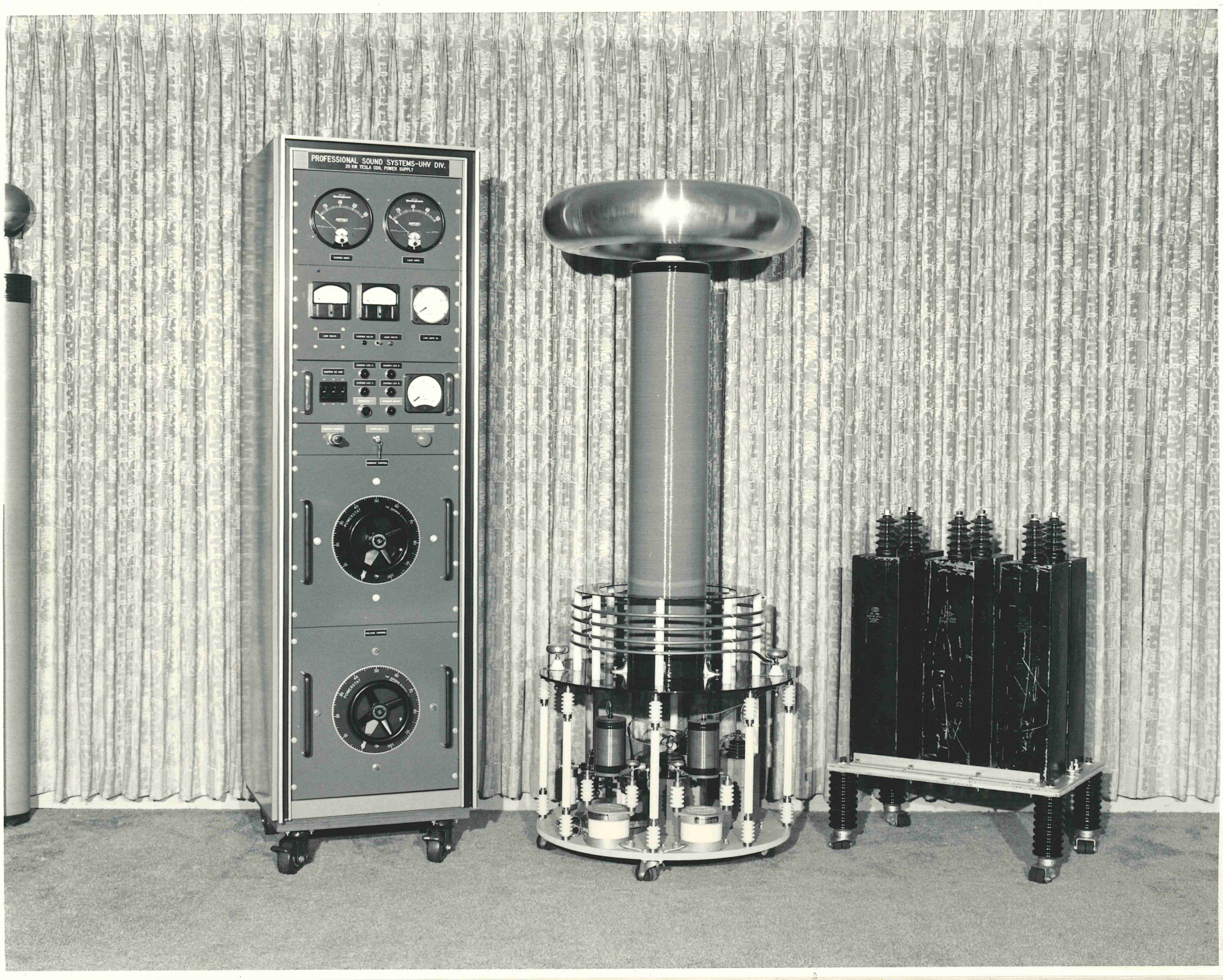
(REDUCE 50%)

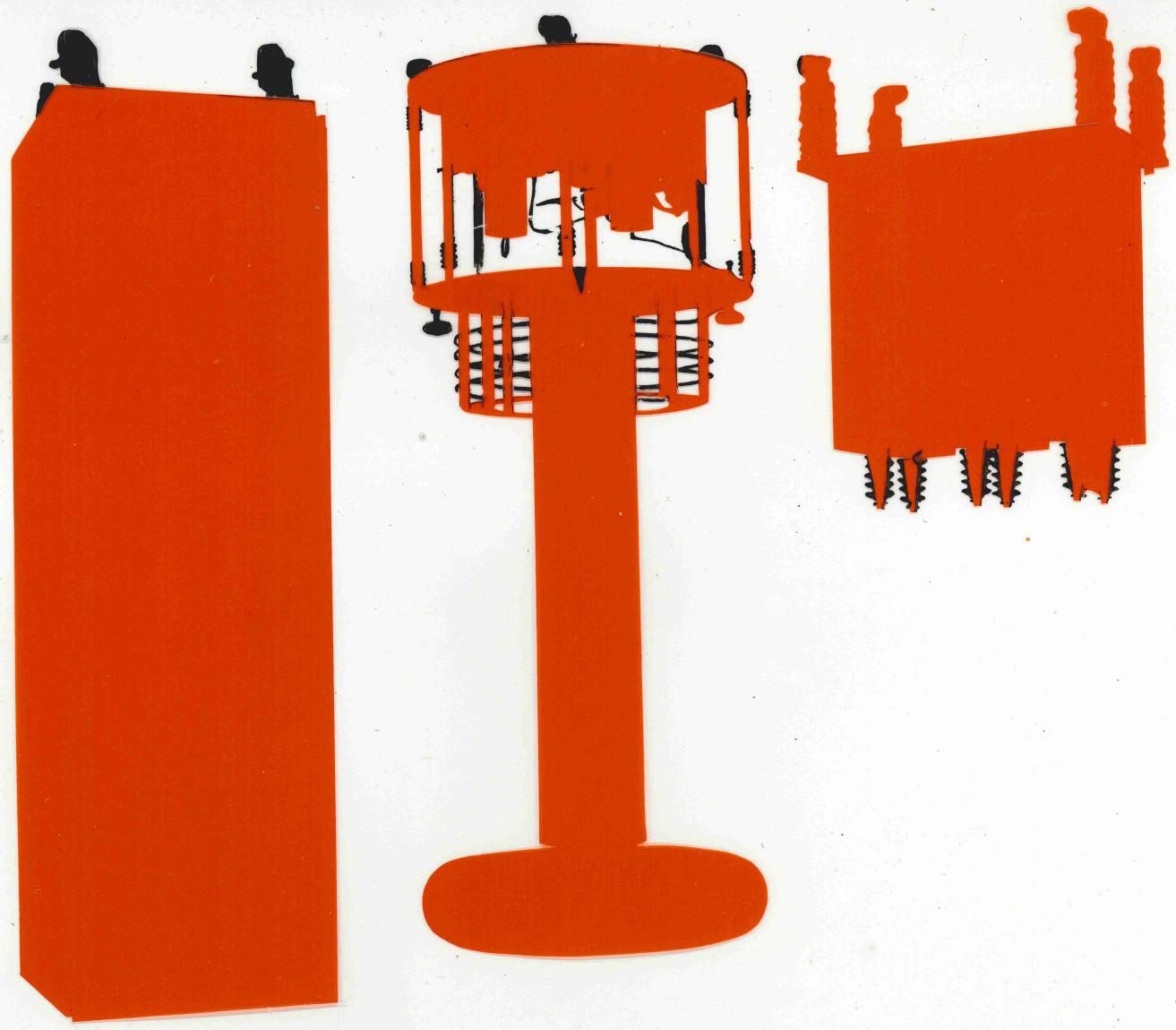
FEB 82

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

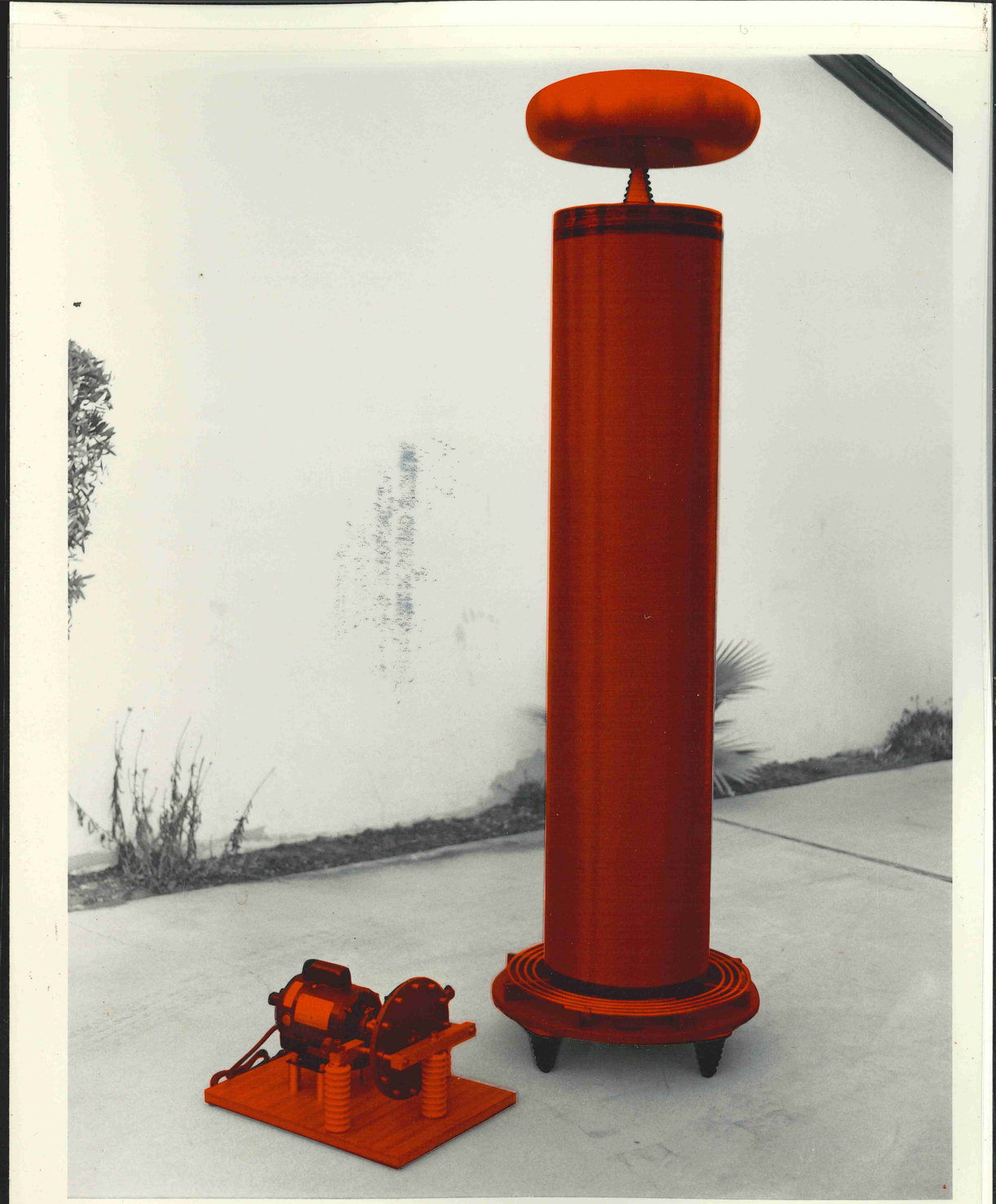
Pg 3 82% Burn out background

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

PAGE 2

PHOTO ID

(FULL SIZE)

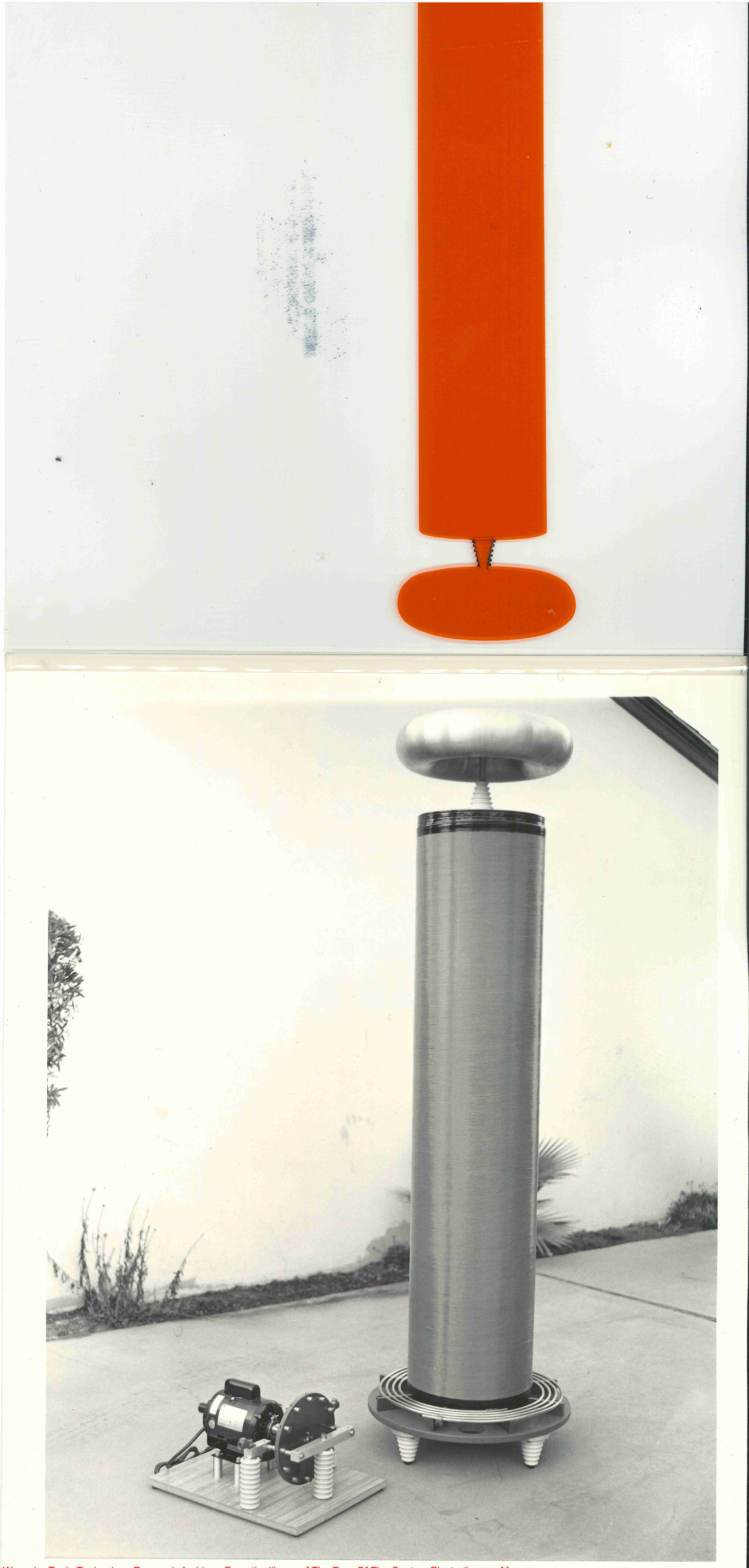
MODEL 8.5 COIL

FEB '82

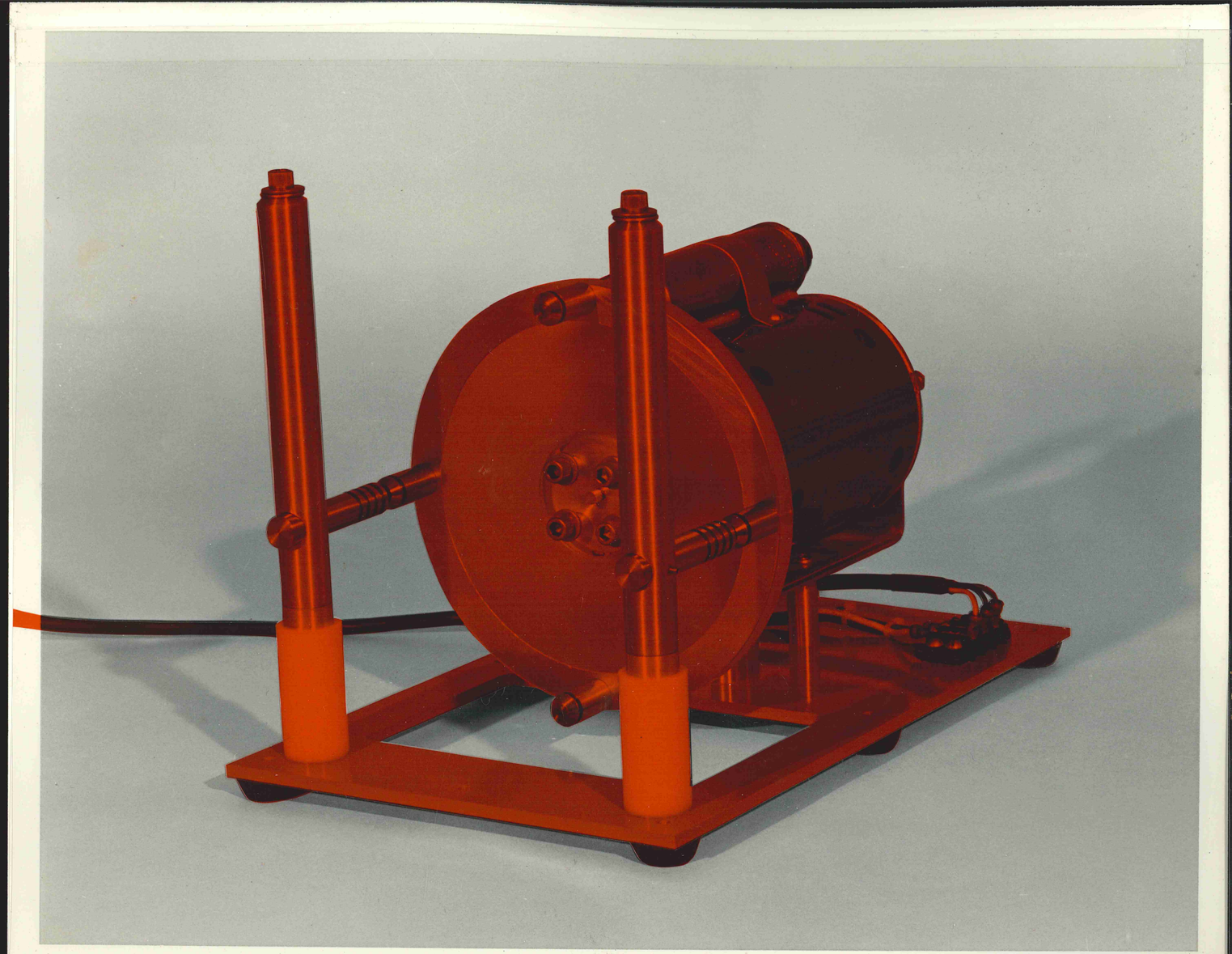
PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

PG 4 117 burnout background

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



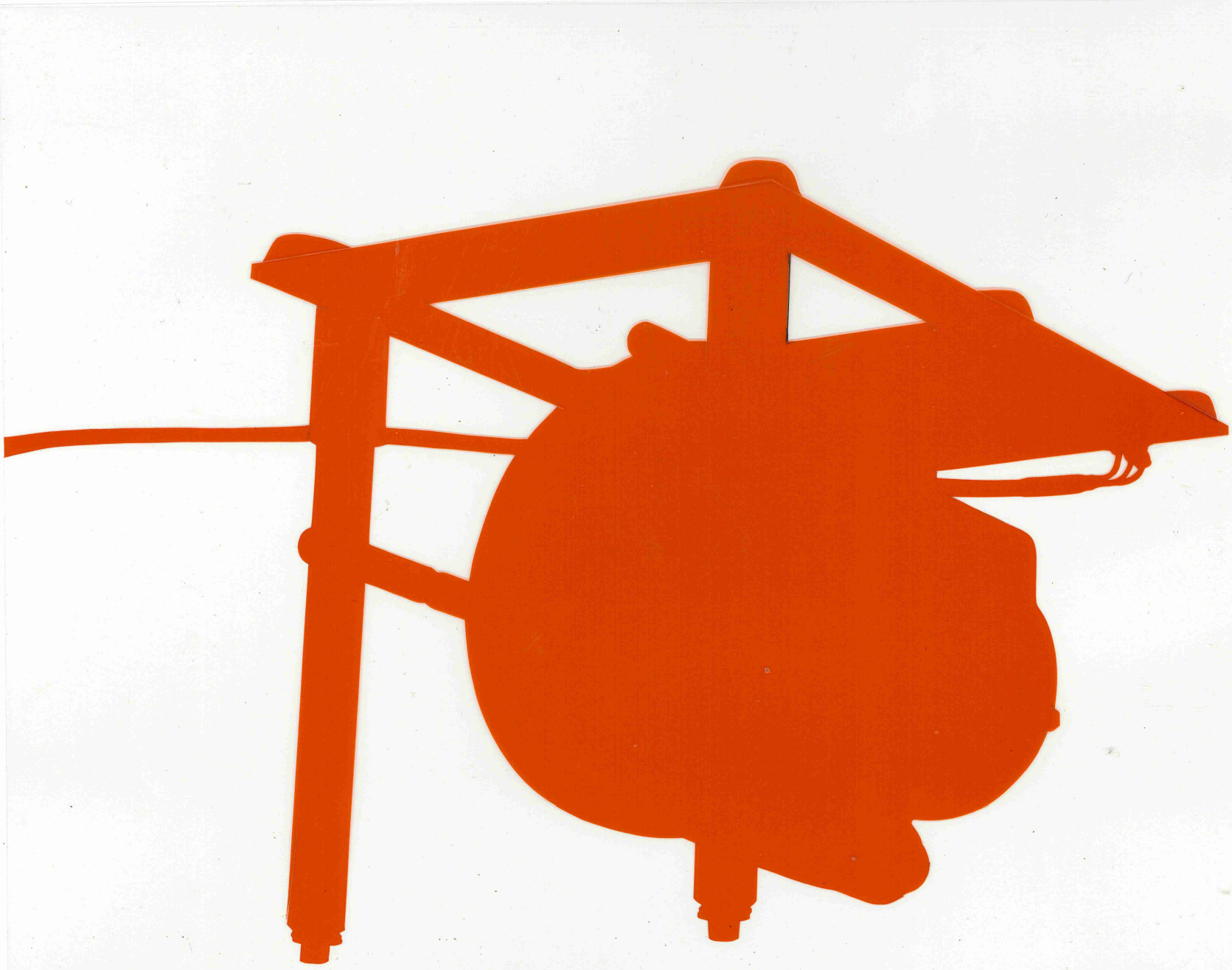
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

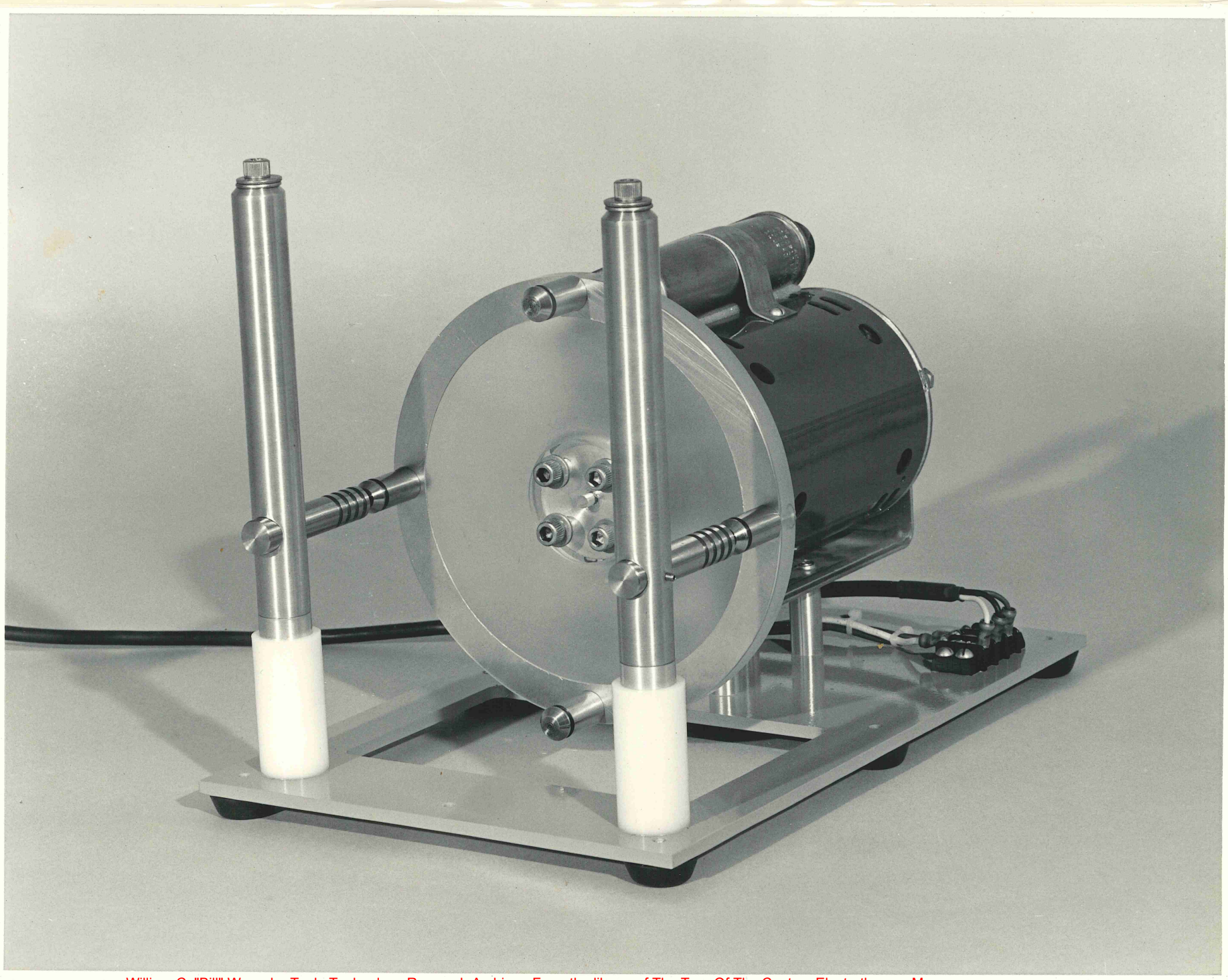
SYNCRONOUS ROTARY
GAP
SHOOT DOWN 50%
FGB 82
PHOTO 1 I

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

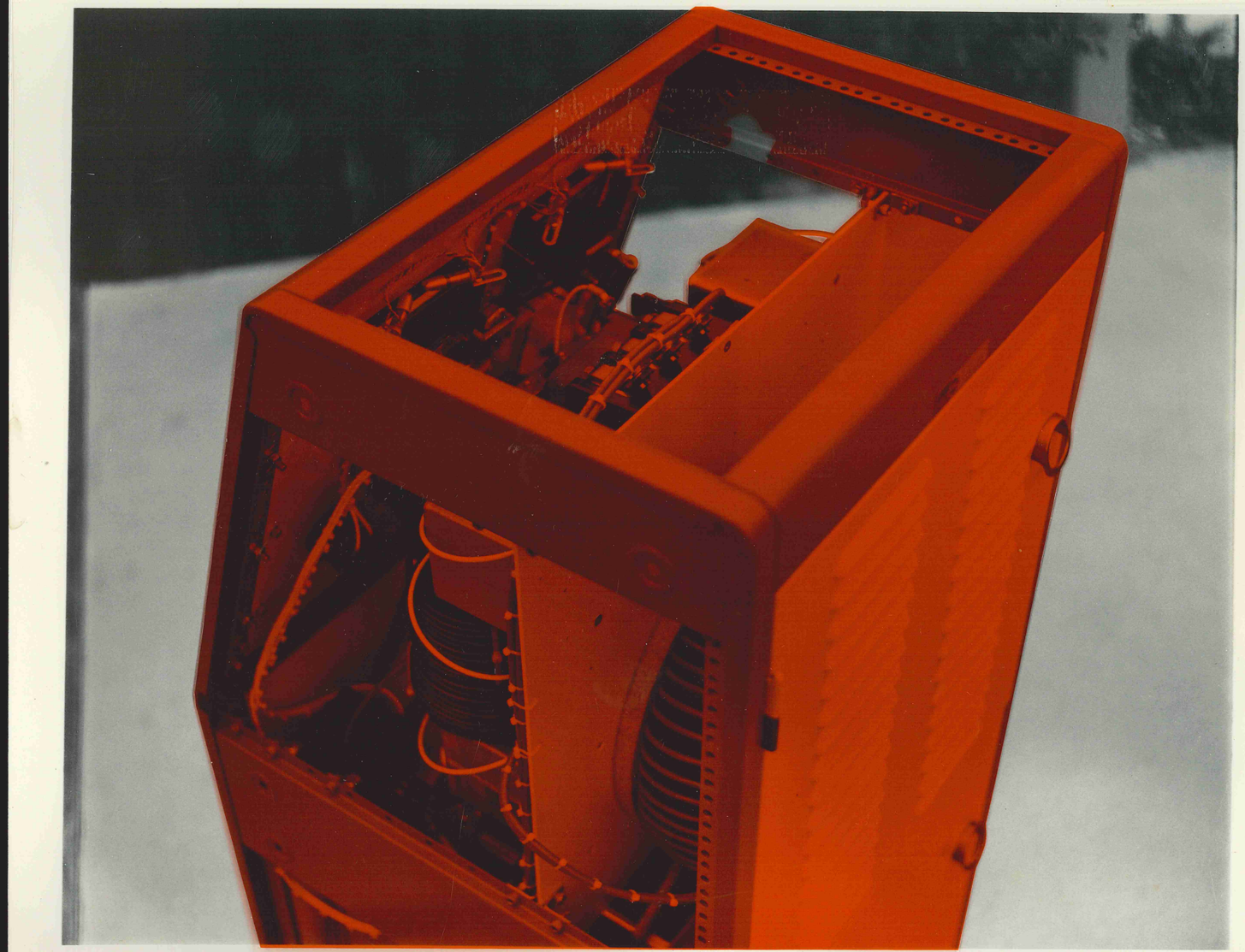
P99 (B) 85% Burn out Background

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

FEB '82

SUPER MODEL 9

TESLA COIL POWER SUPPLY

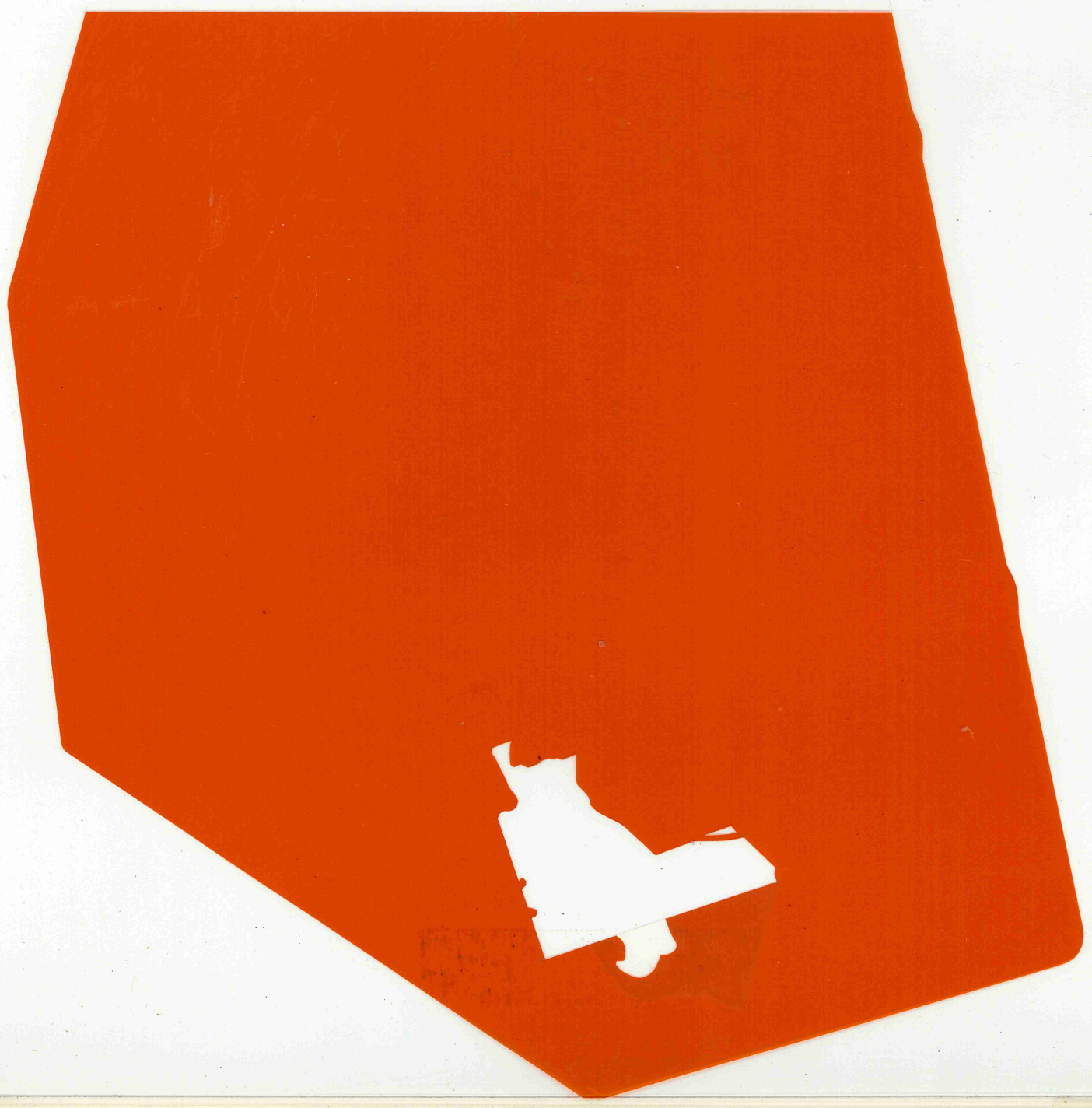
SHOOT DOWN 50%

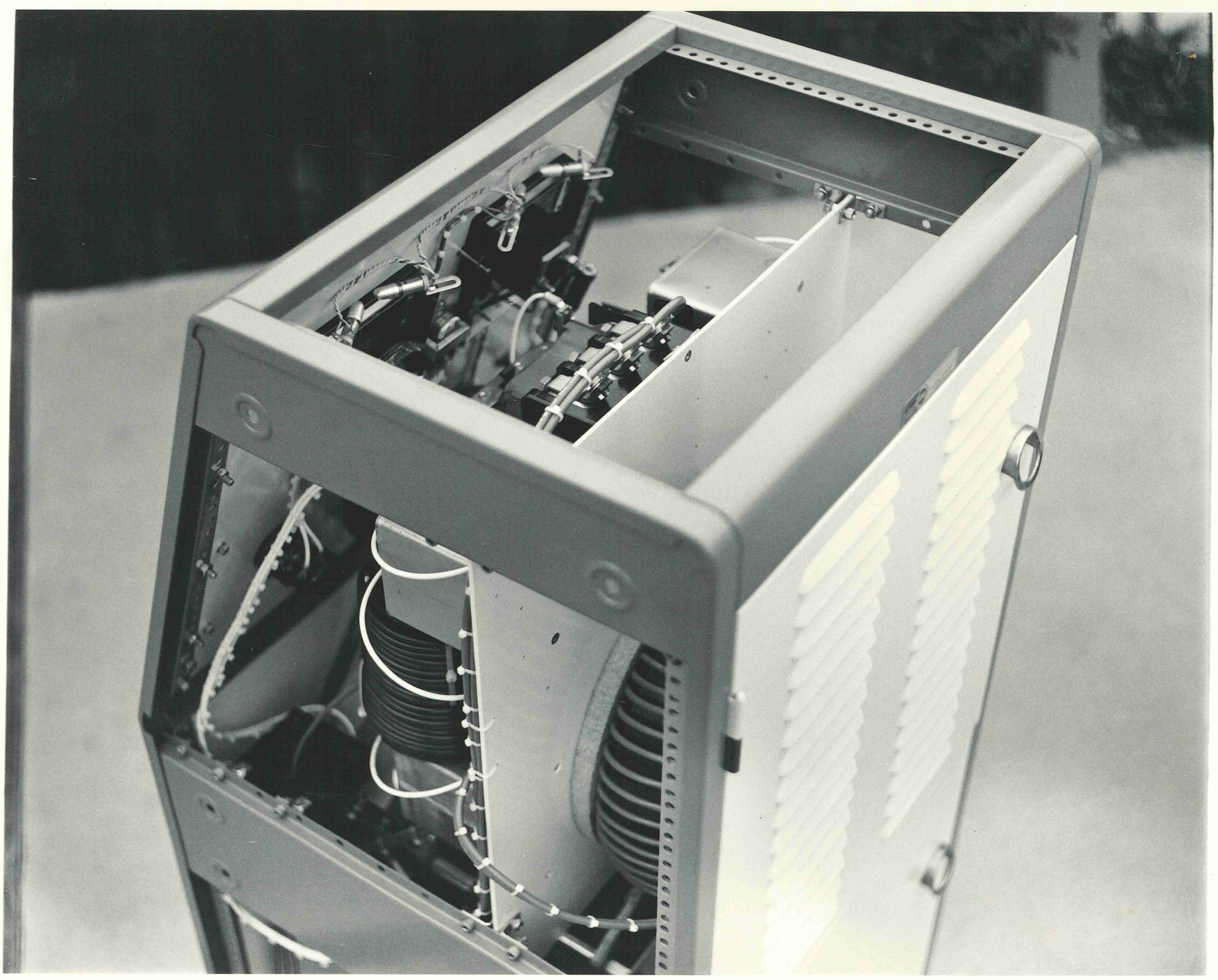
PHOTO 1 ~~H~~

pg 9 ① 70½% burn out background

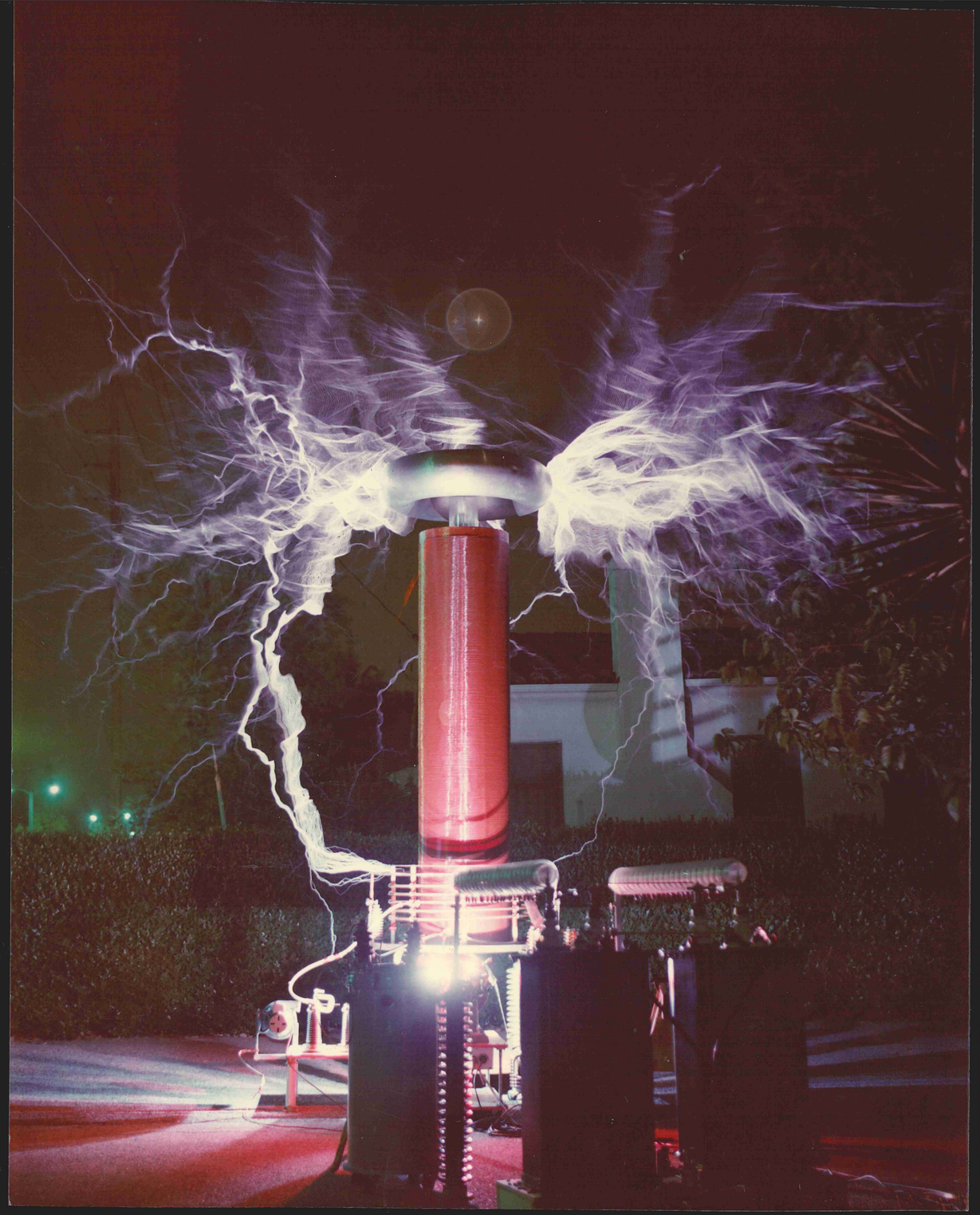
PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

FRONT COVER
PHOTO 1A
(OUTSIDE FLAP)
FEB. 82
SHOOT FULL SIZE

PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

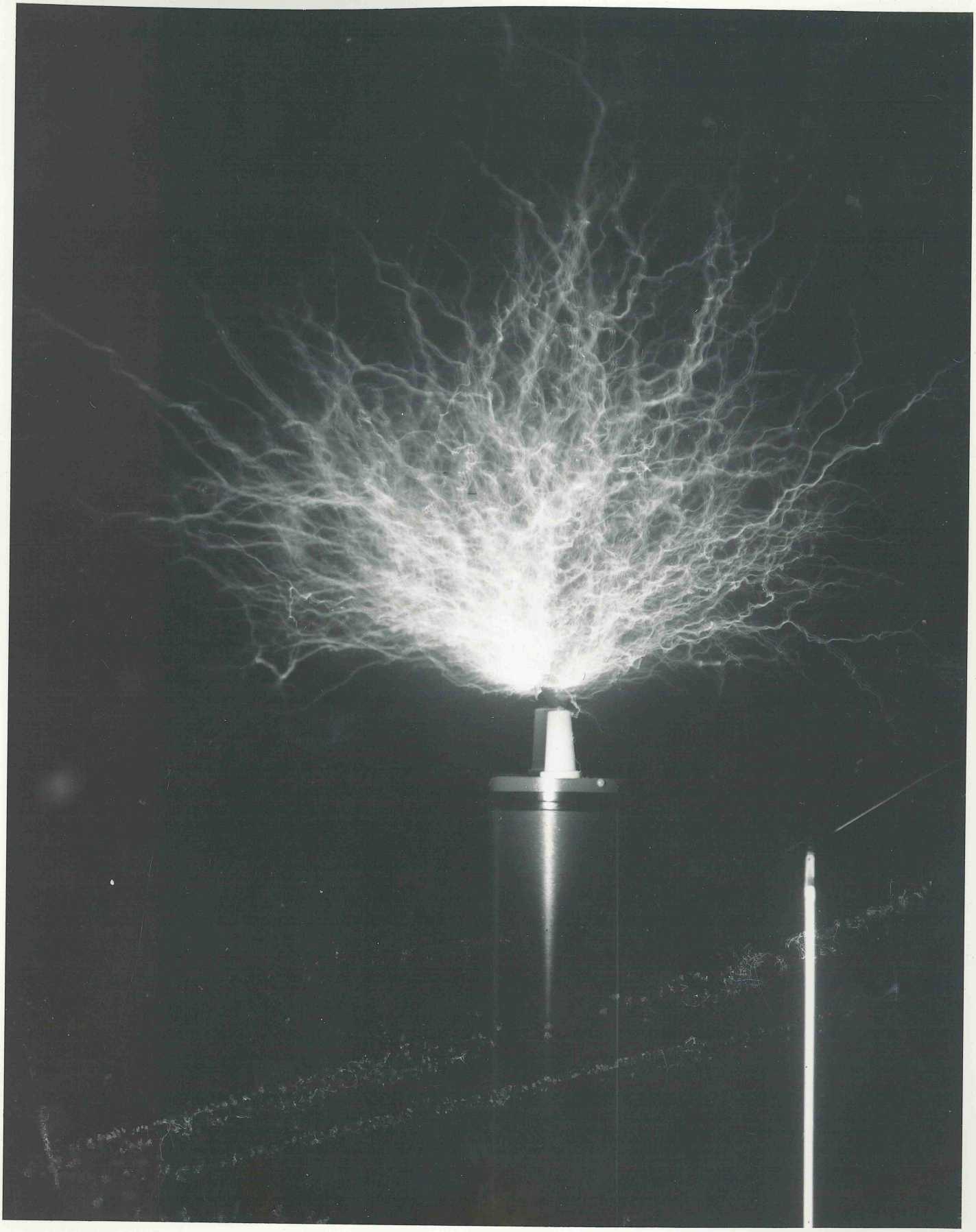
OFC 110% Page 1

BACK COVER
~~PHOTO~~ 1J
(OUTSIDE FLAP)
SHOOT FULL SIZE
FEB '82

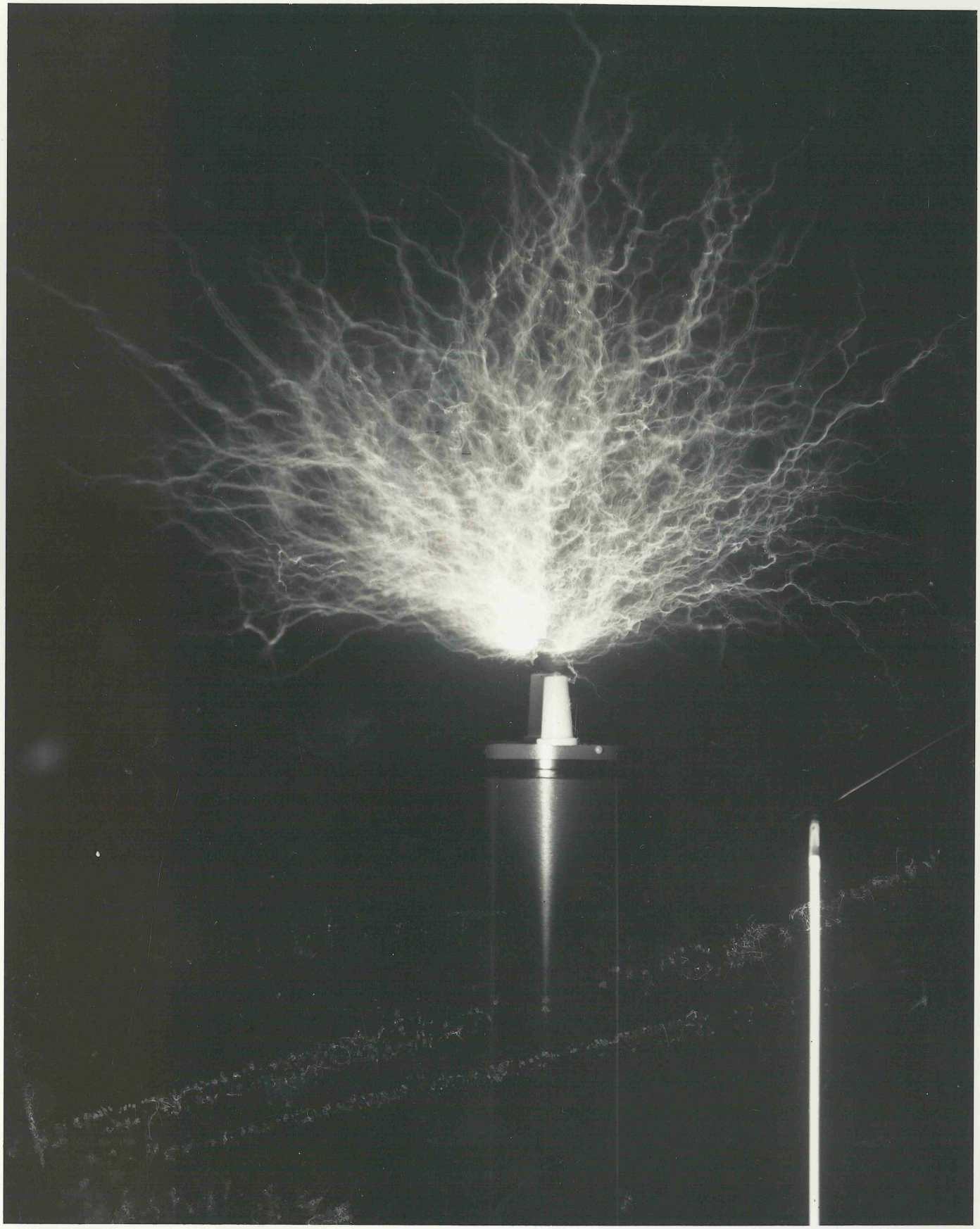
PROFESSIONAL SOUND SYSTEMS
ULTRA HIGH VOLTAGE DIV.
2527 Treelane Ave.
Monrovia, Ca 91016

125% OBC Pg12

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



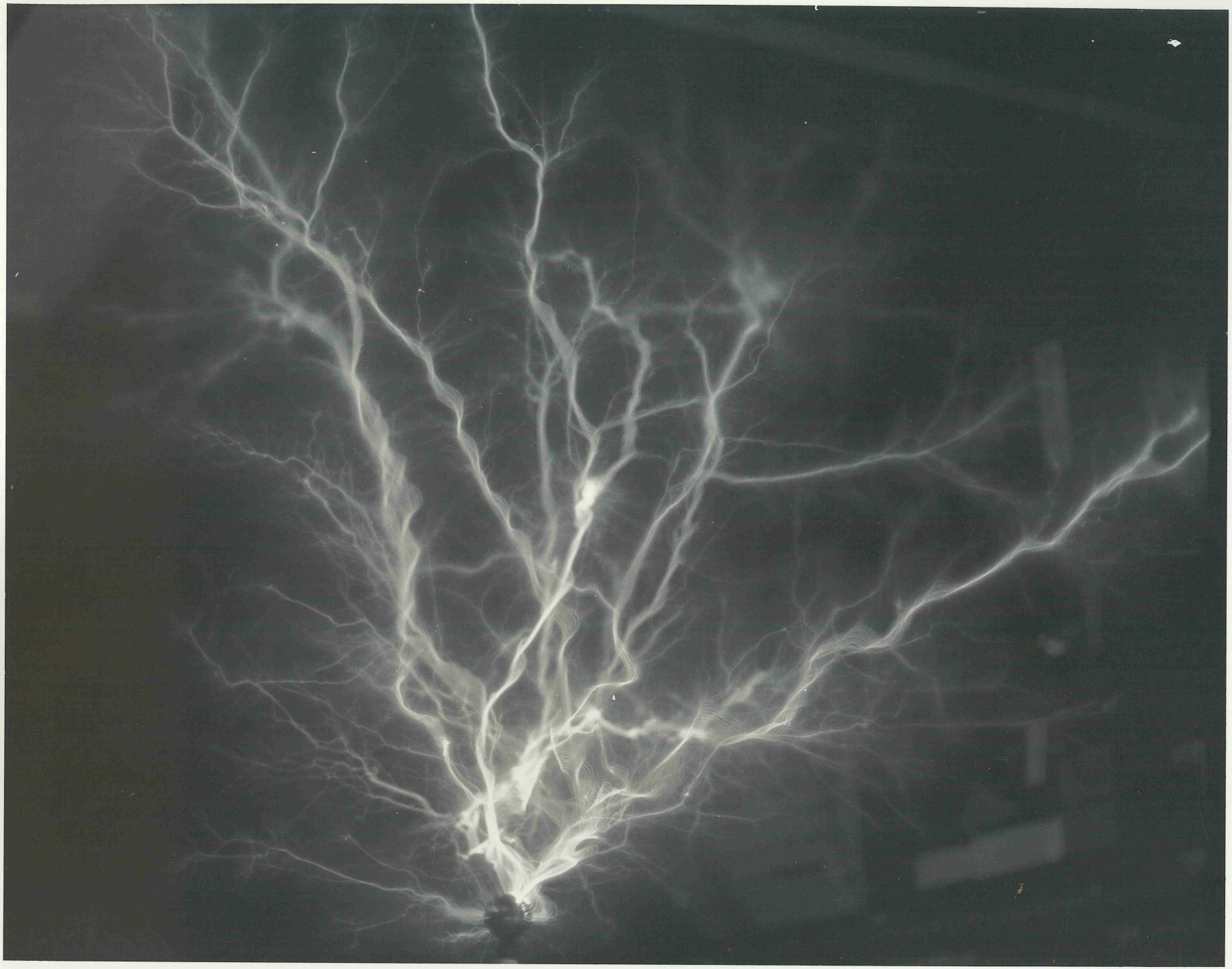
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



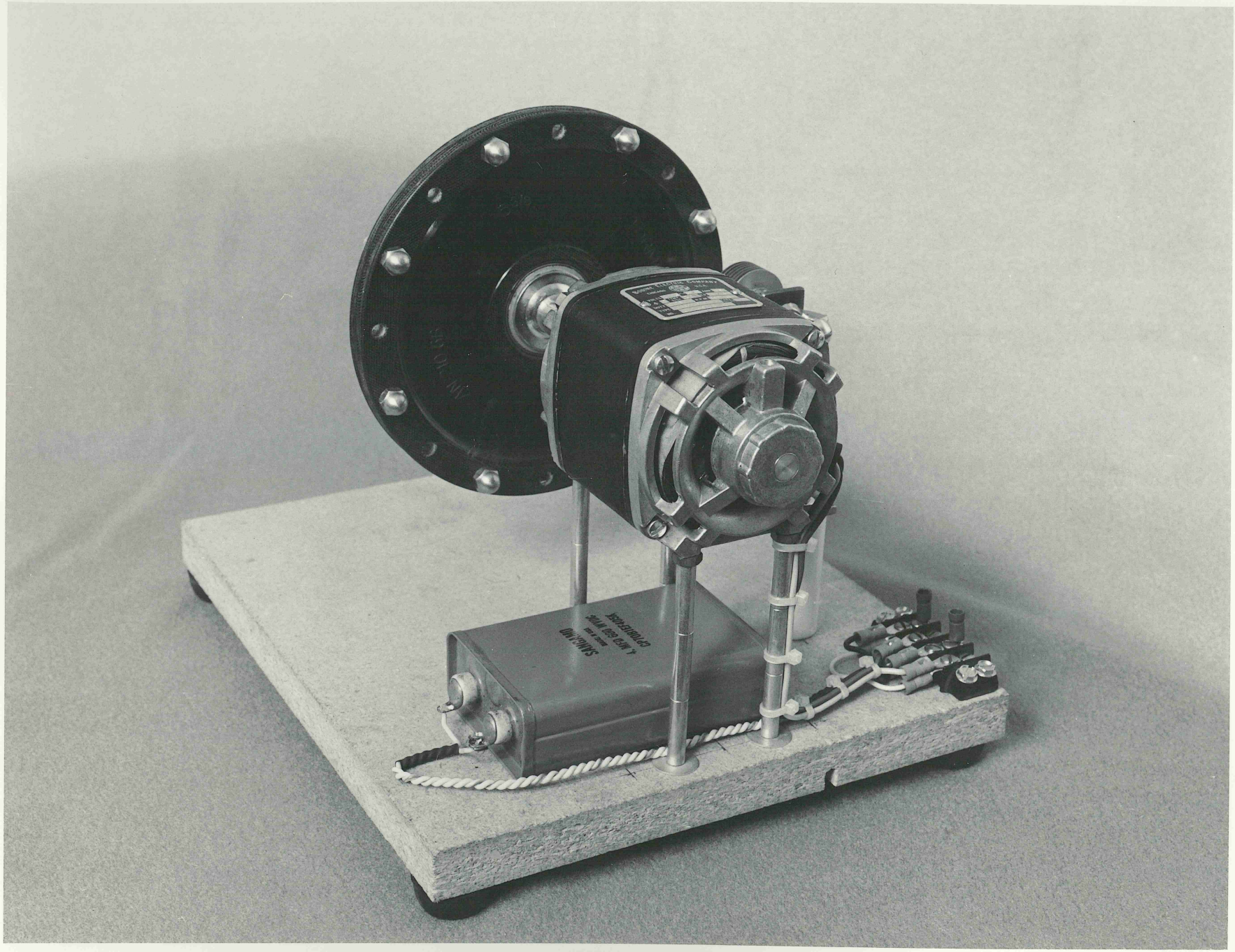
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



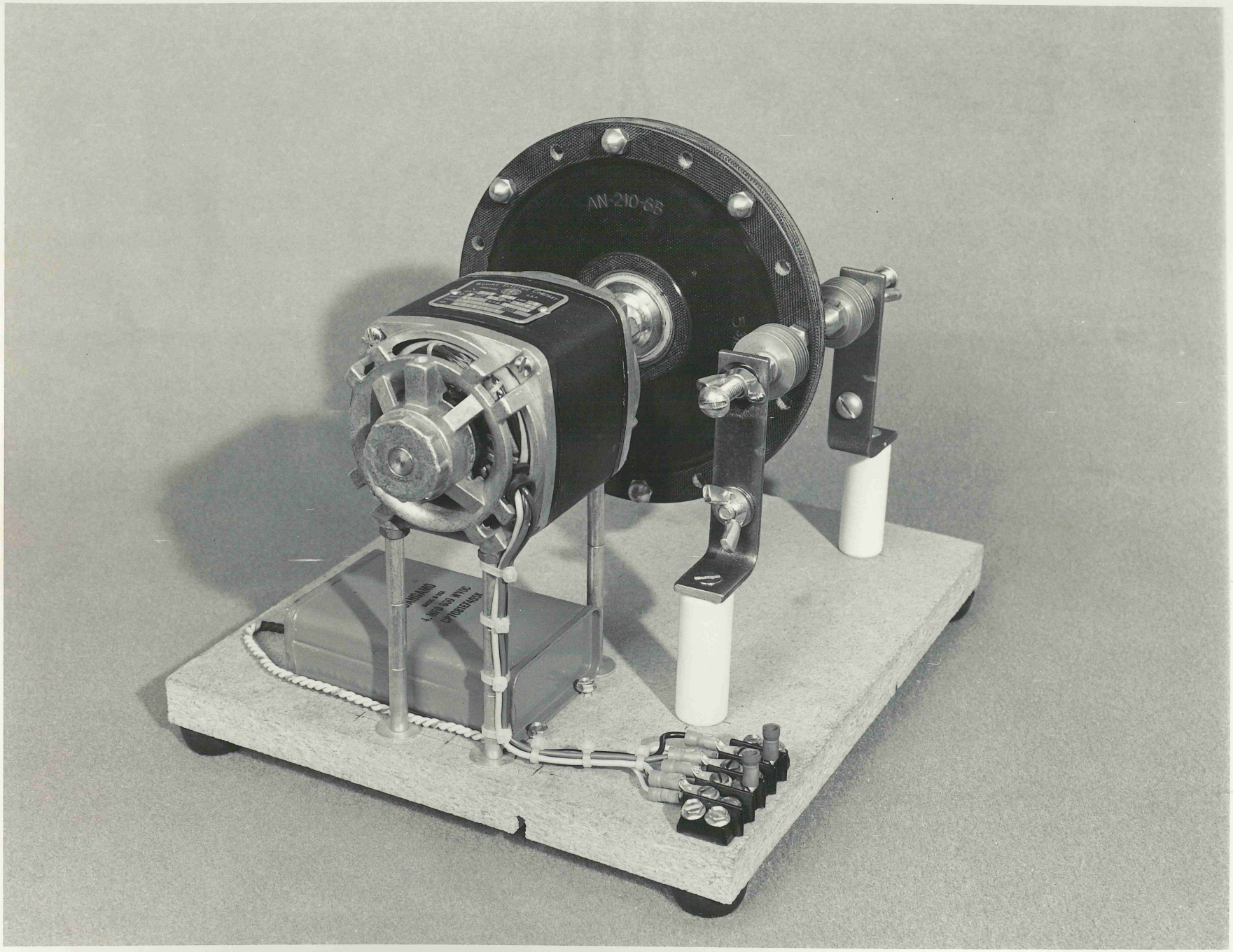
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



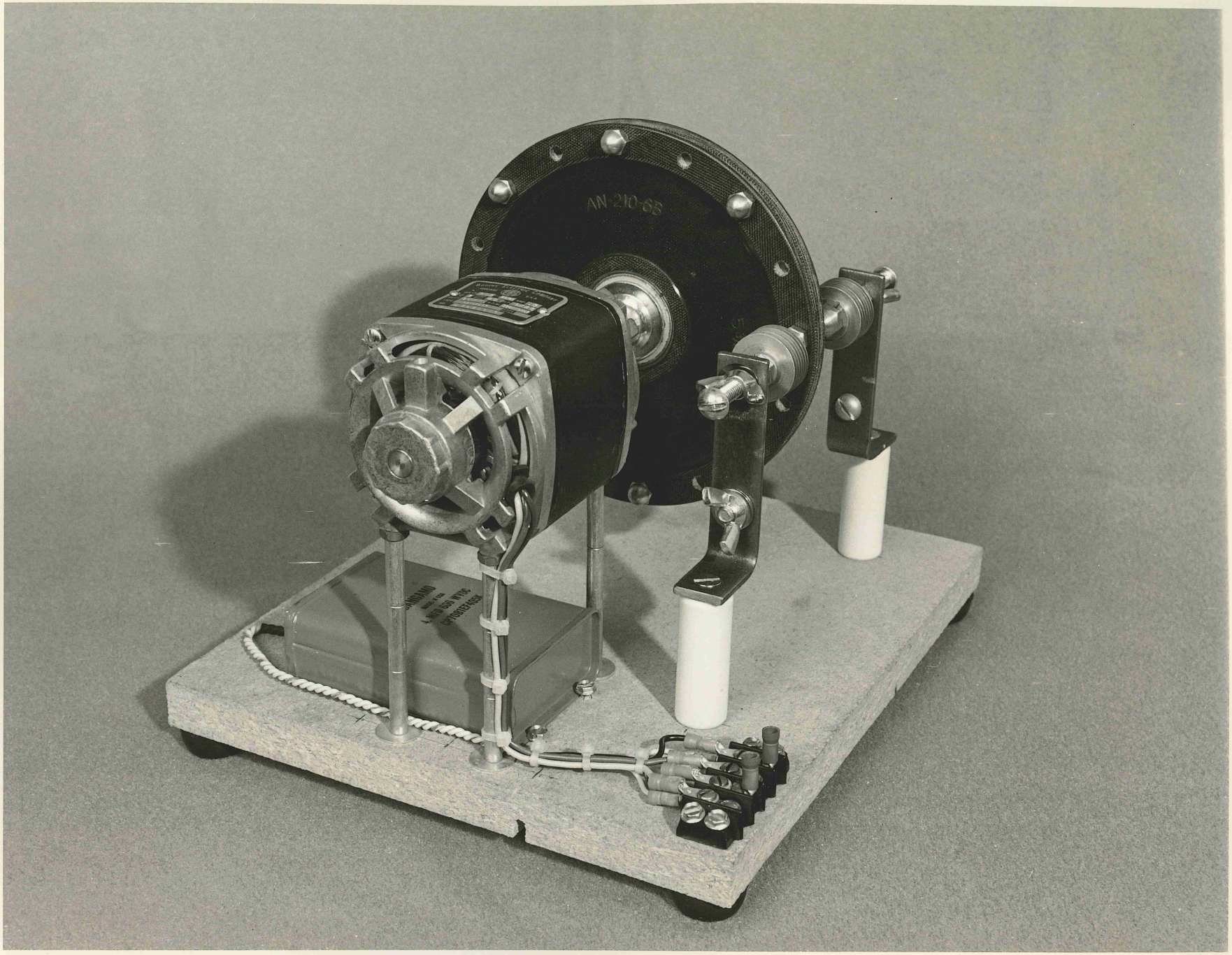
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



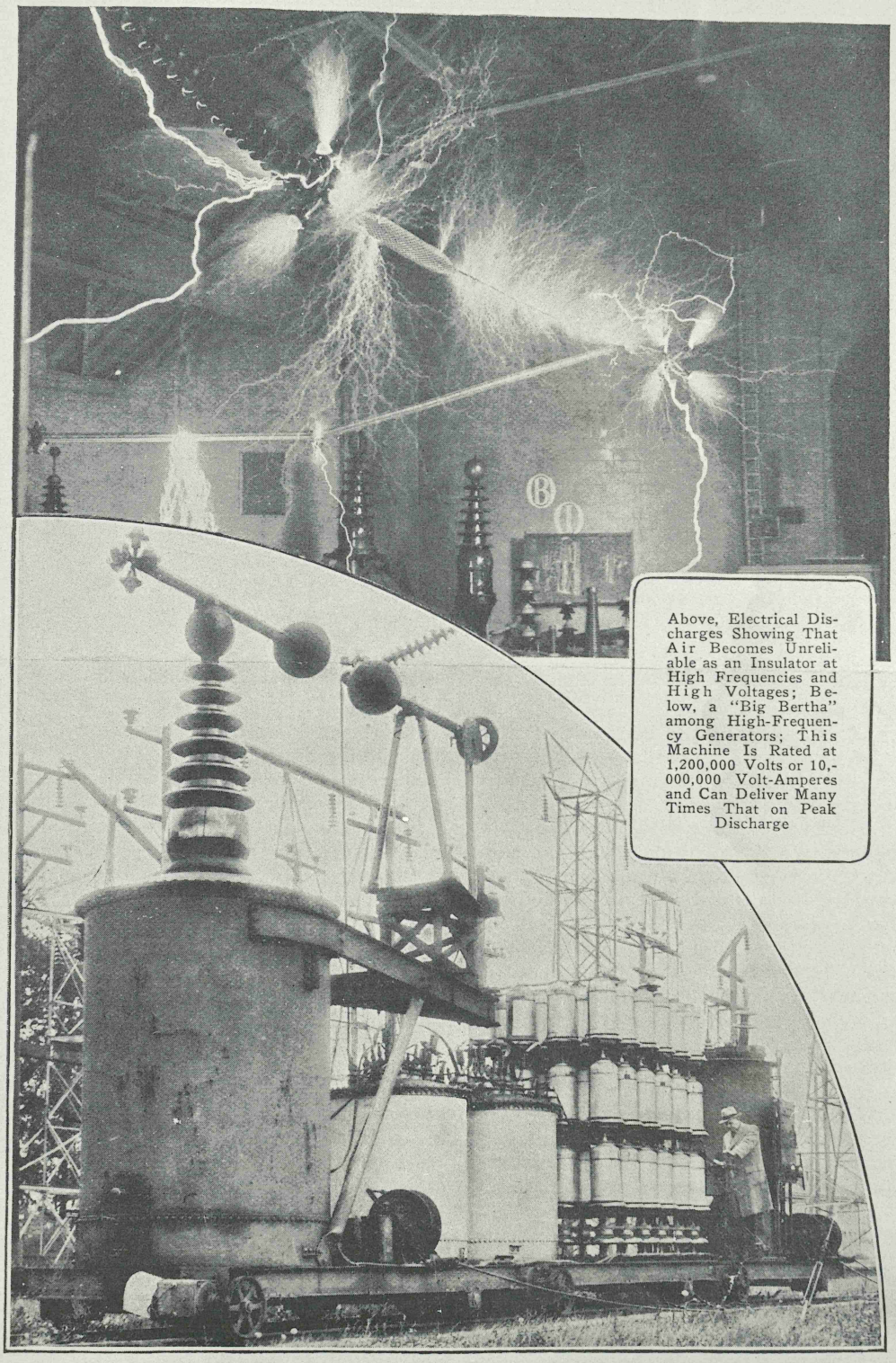
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

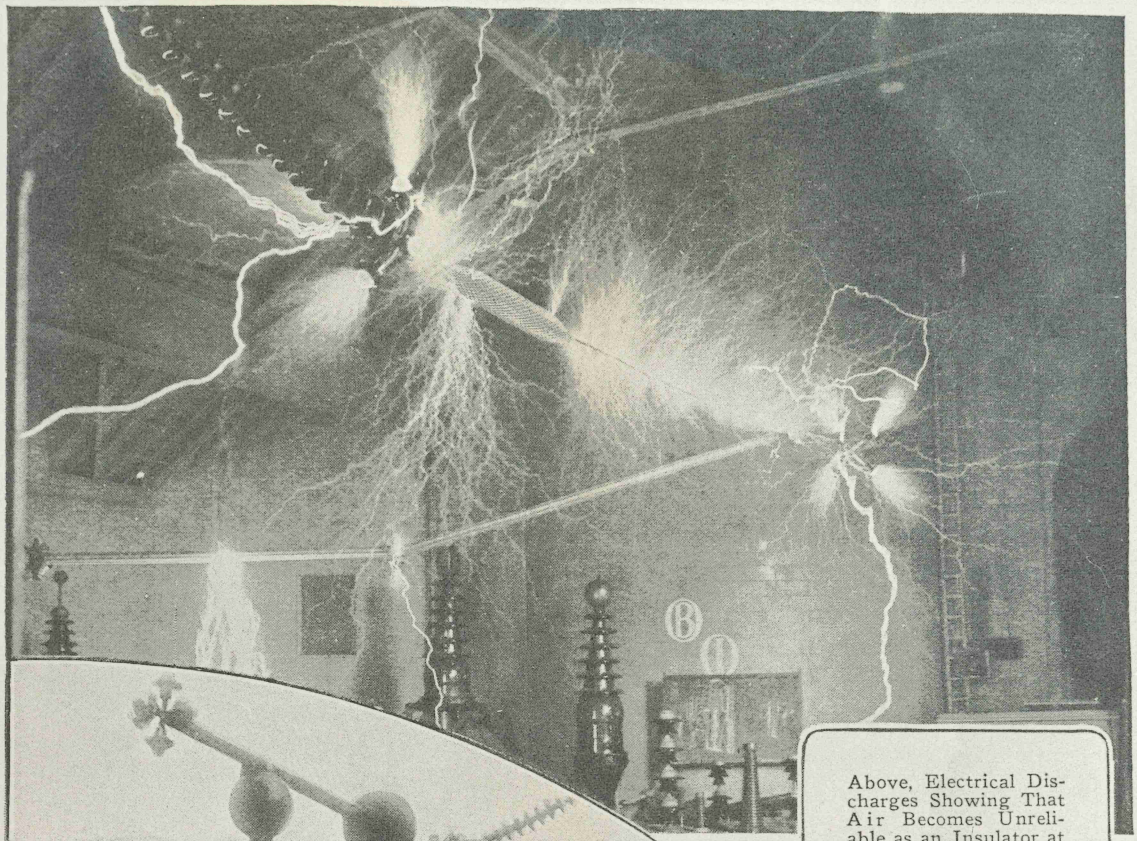


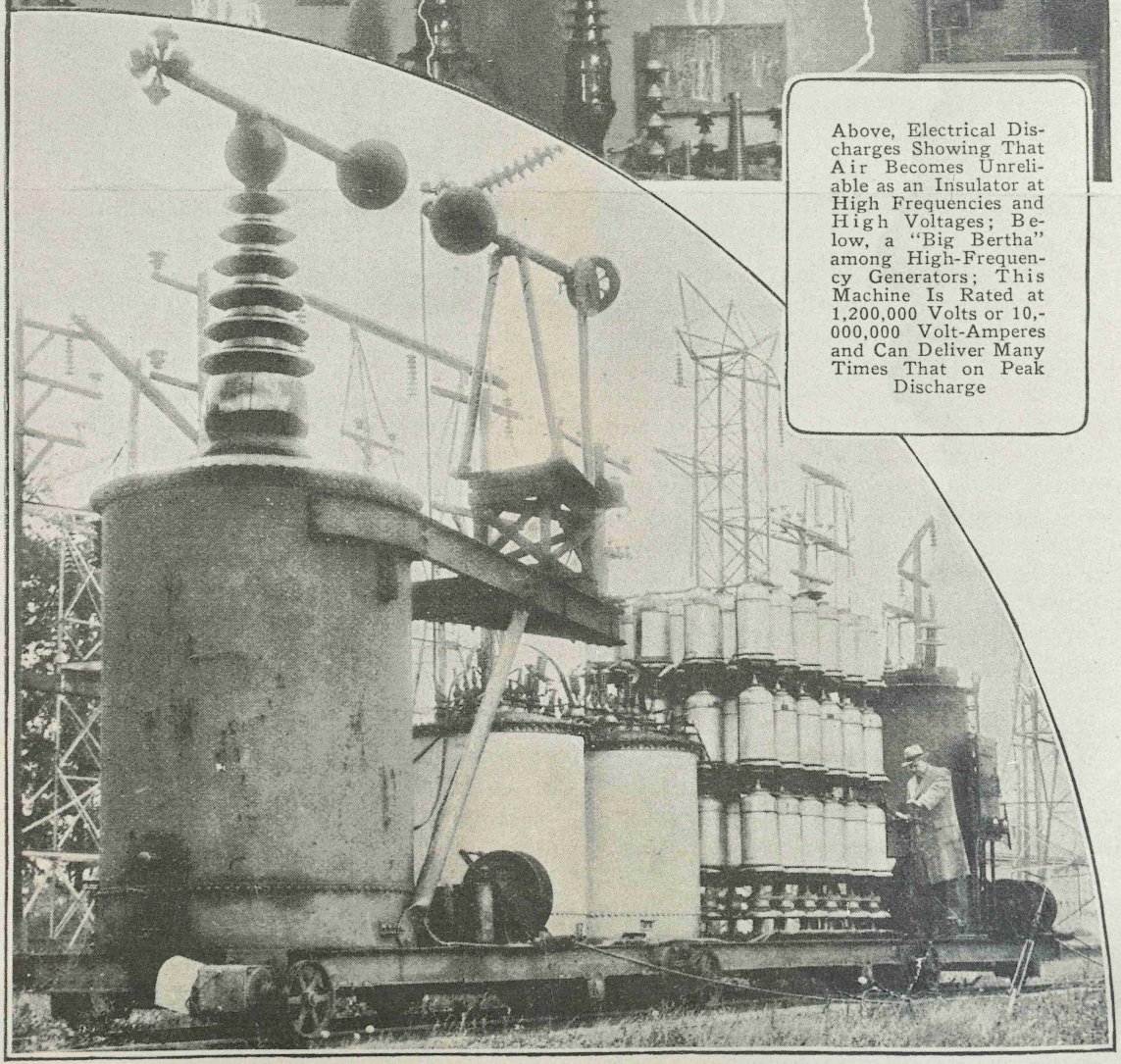
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



Above, Electrical Discharges Showing That Air Becomes Unreliable as an Insulator at High Frequencies and High Voltages; Below, a "Big Bertha" among High-Frequency Generators; This Machine Is Rated at 1,200,000 Volts or 10,000,000 Volt-Amperes and Can Deliver Many Times That on Peak Discharge

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



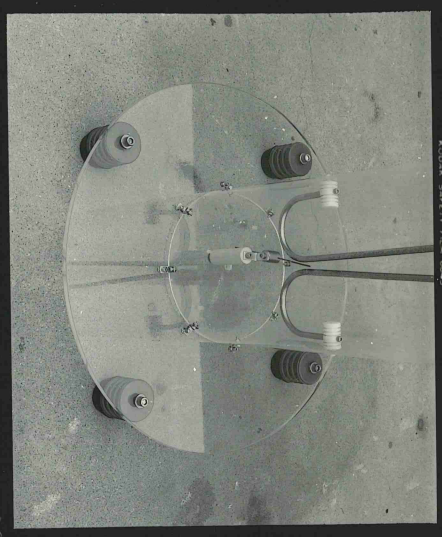


Above, Electrical Discharges Showing That Air Becomes Unreliable as an Insulator at High Frequencies and High Voltages; Below, a "Big Bertha" among High-Frequency Generators; This Machine Is Rated at 1,200,000 Volts or 10,000,000 Volt-Amperes and Can Deliver Many Times That on Peak Discharge

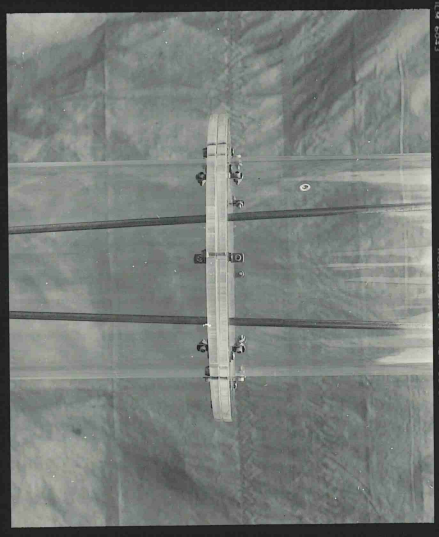
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





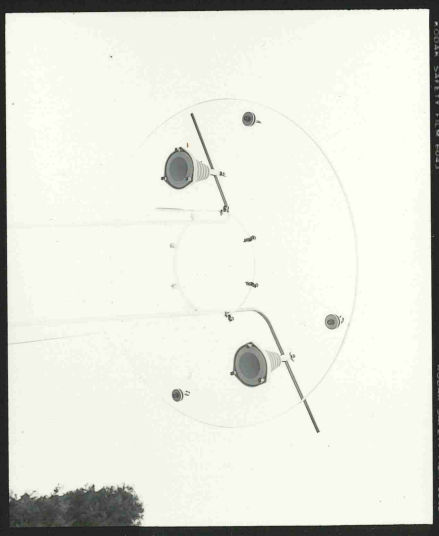






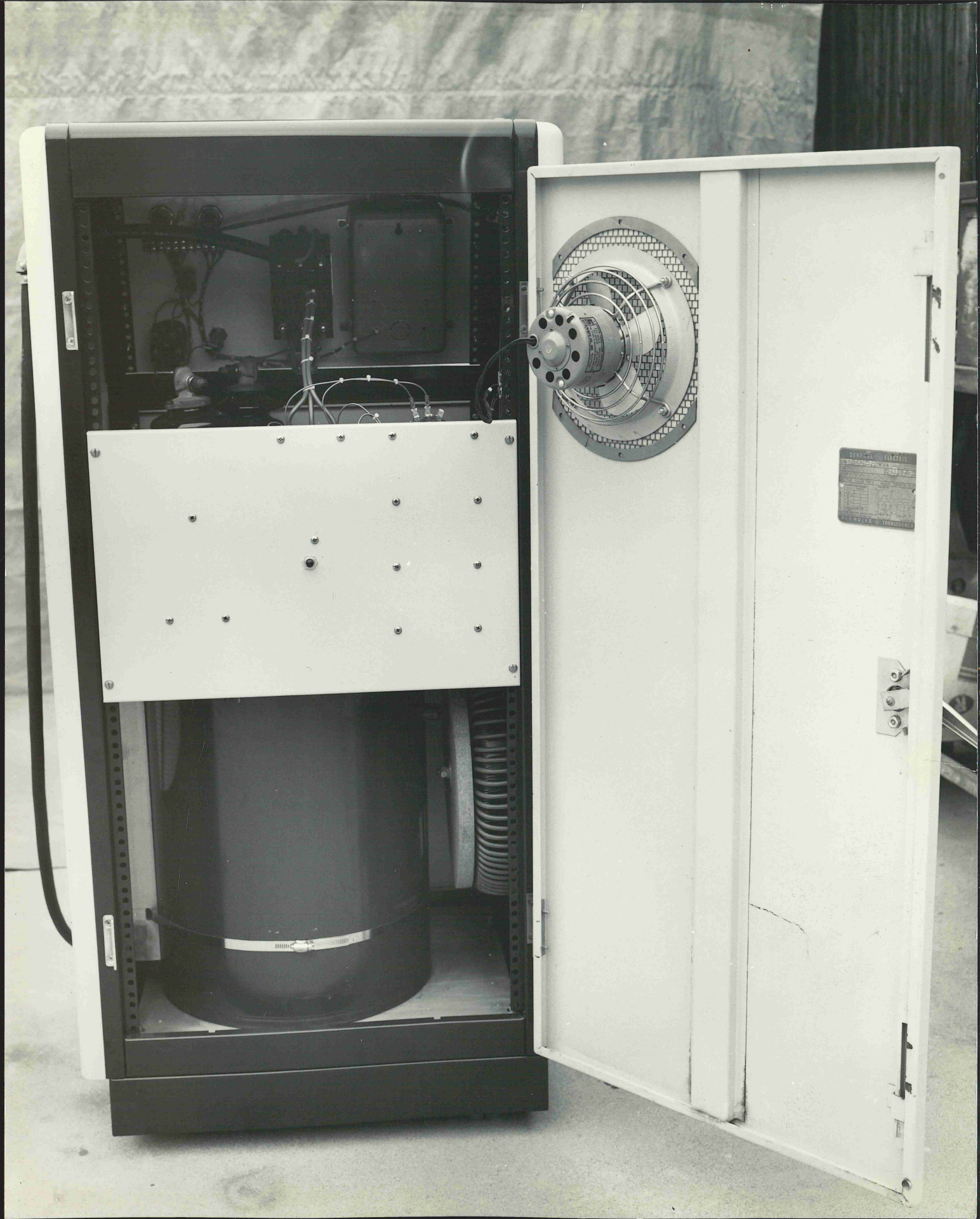








William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

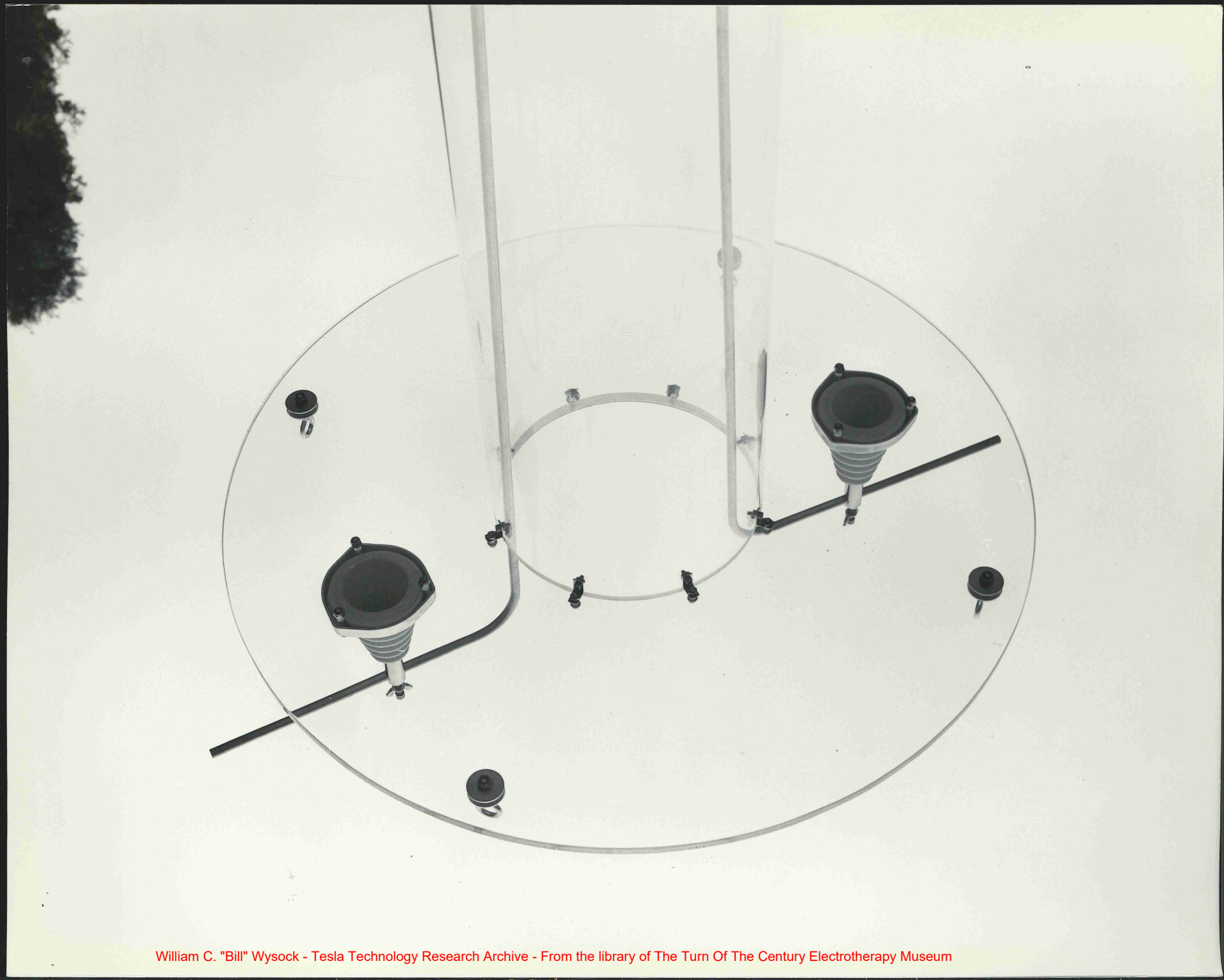


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

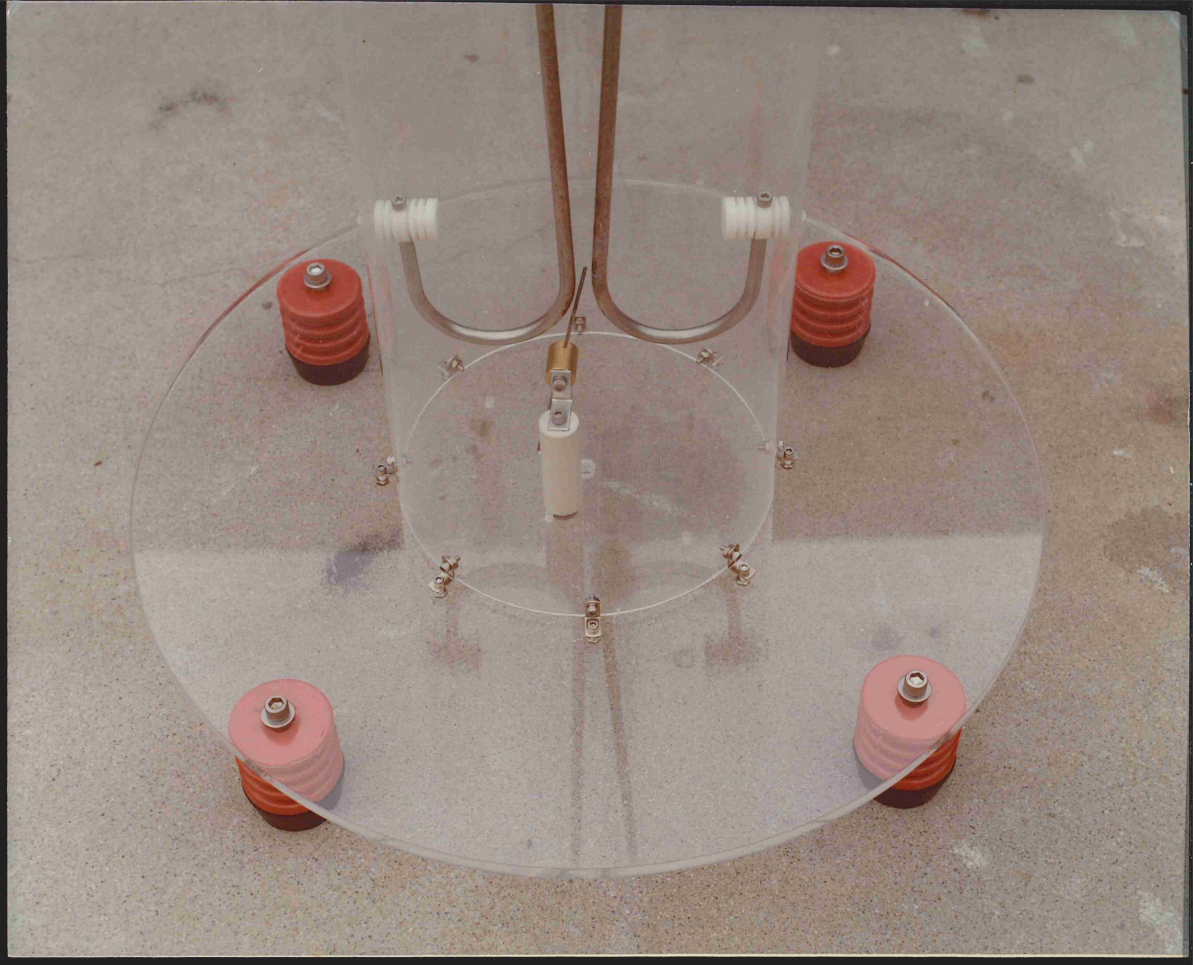
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

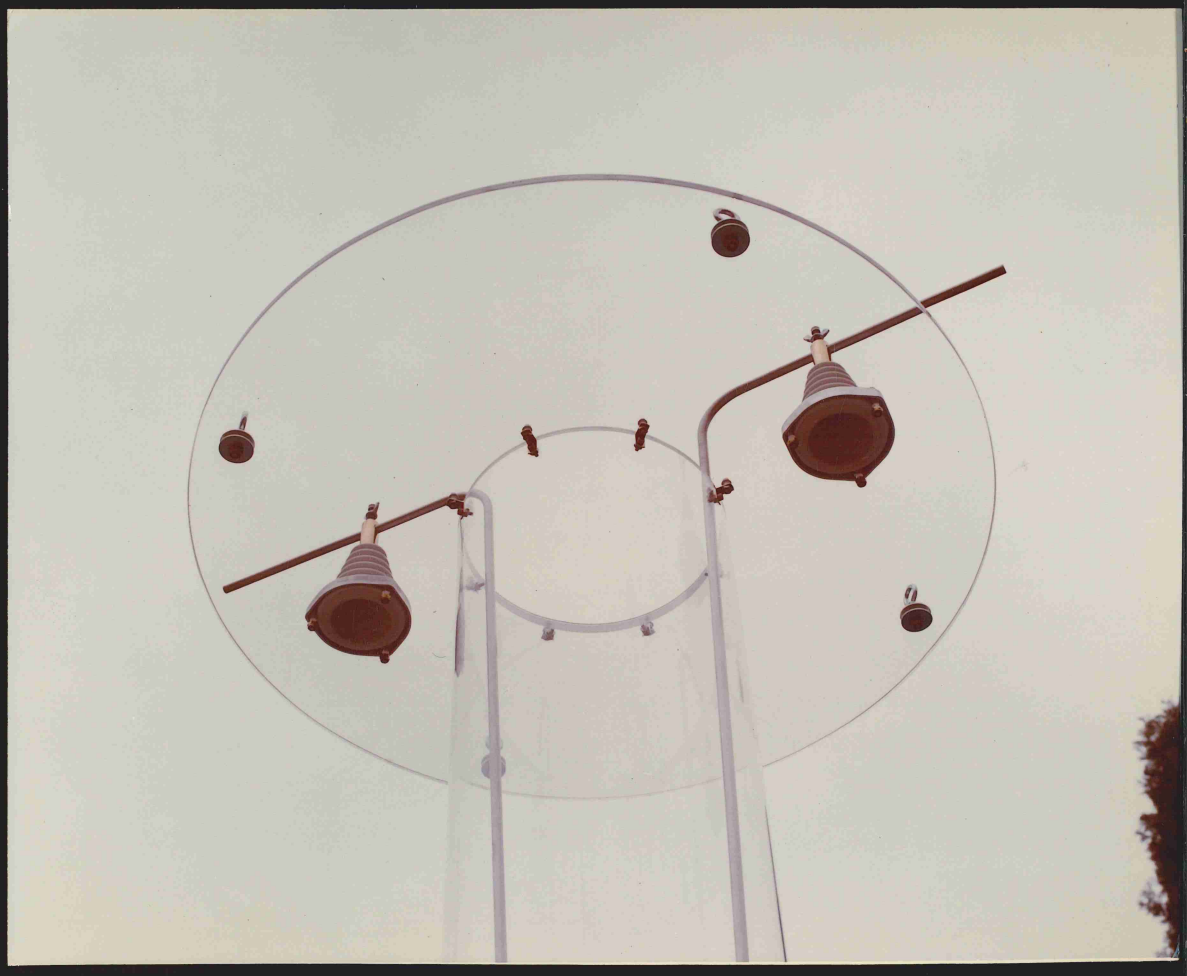


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

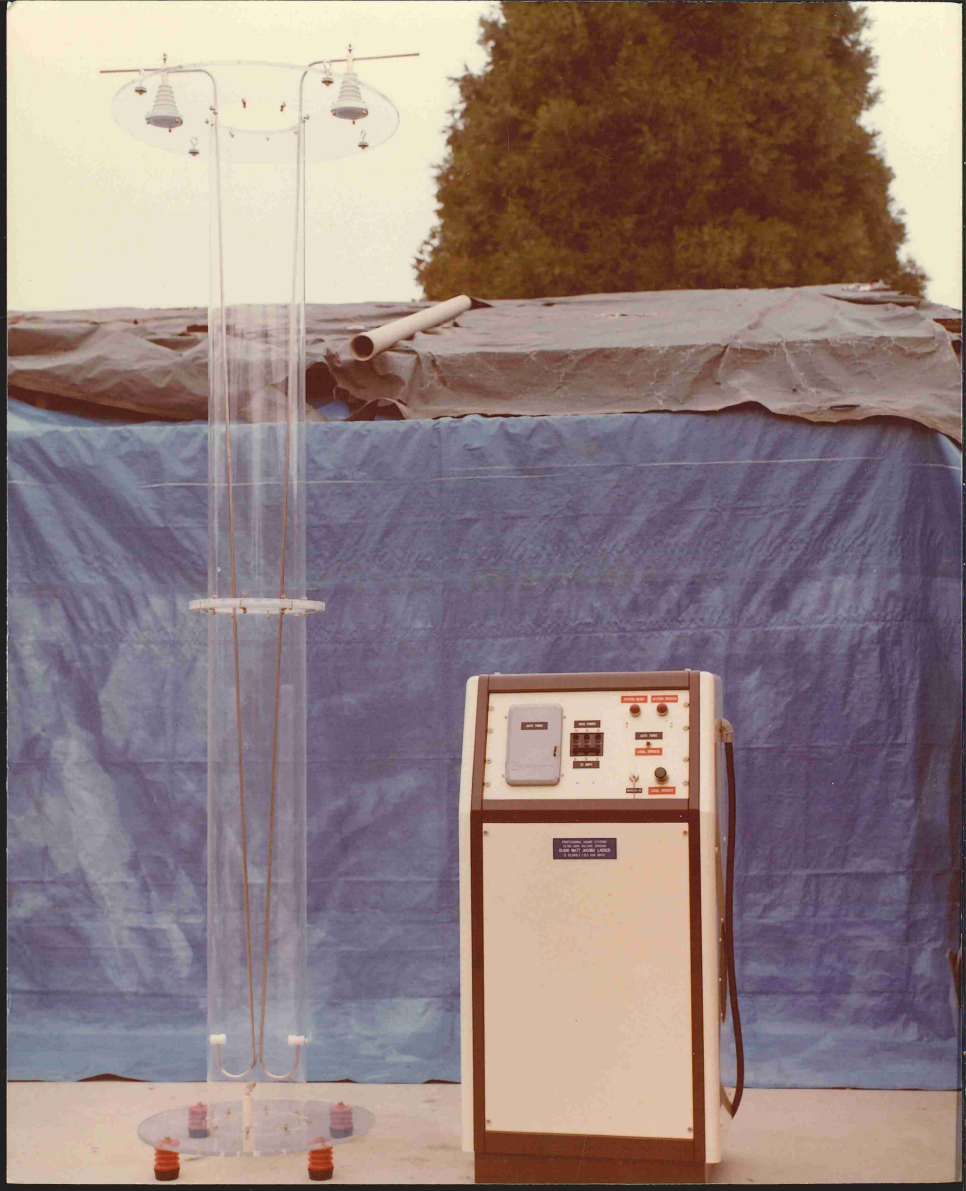




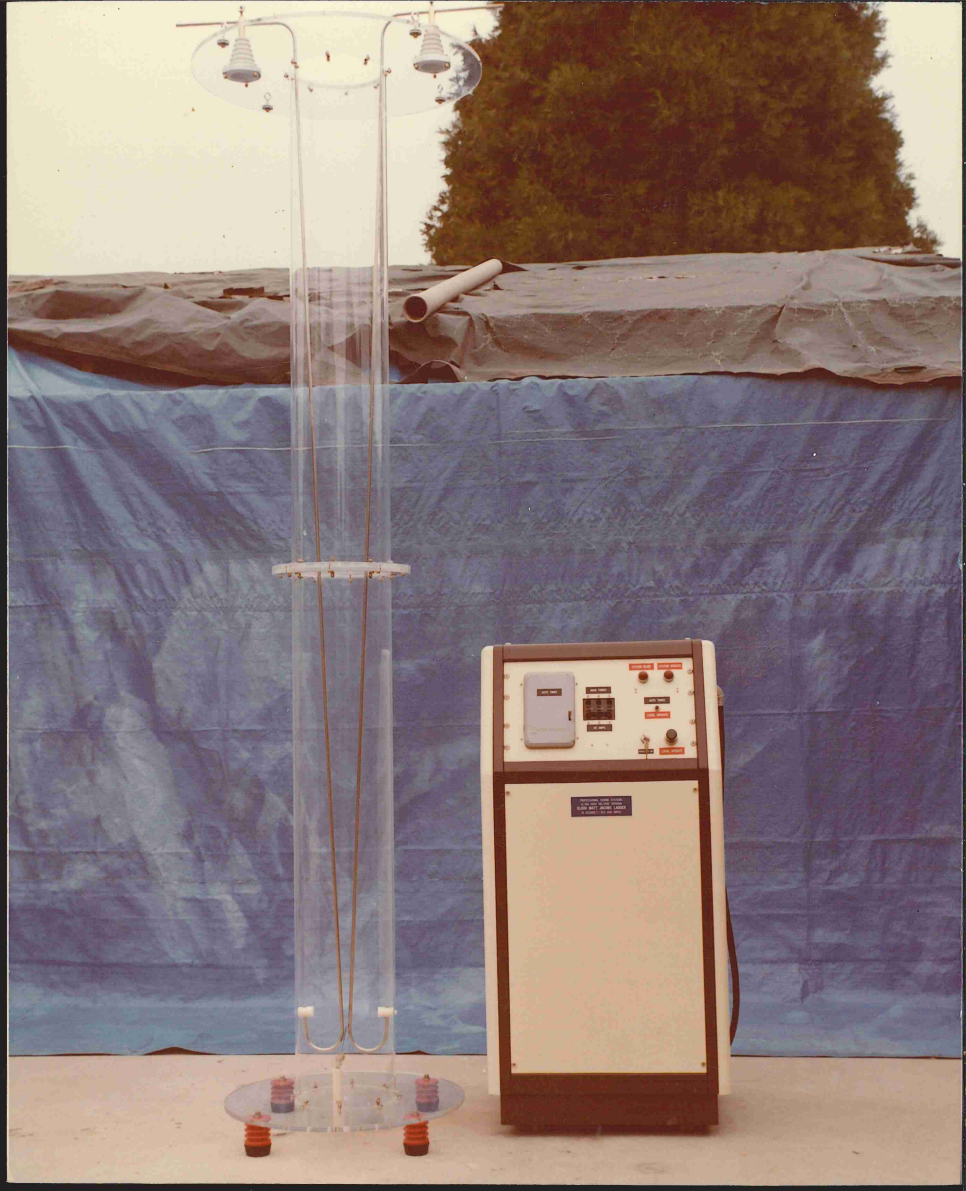
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



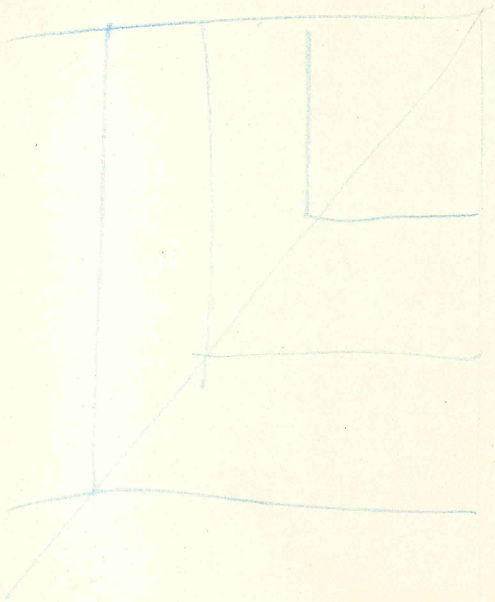
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



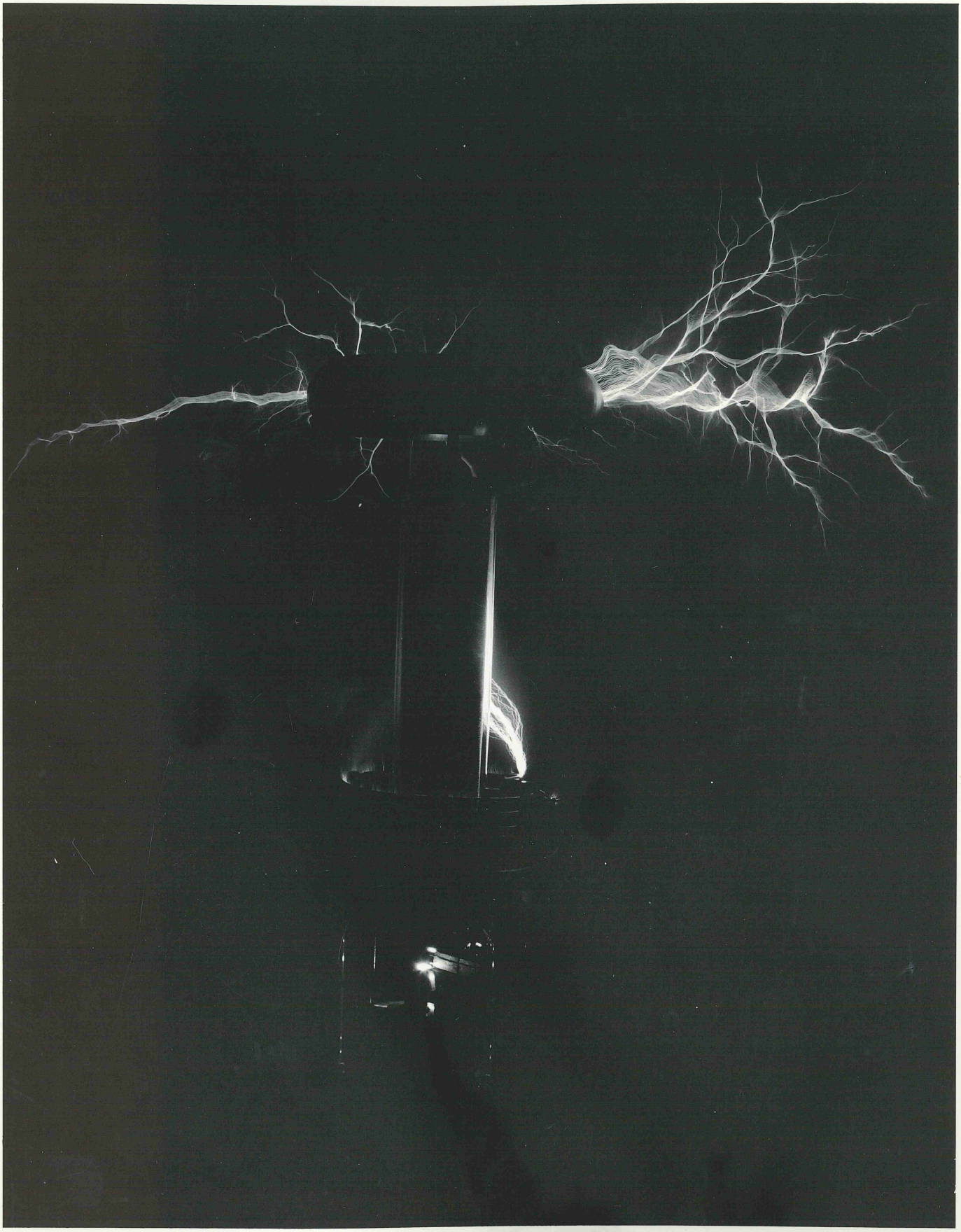
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



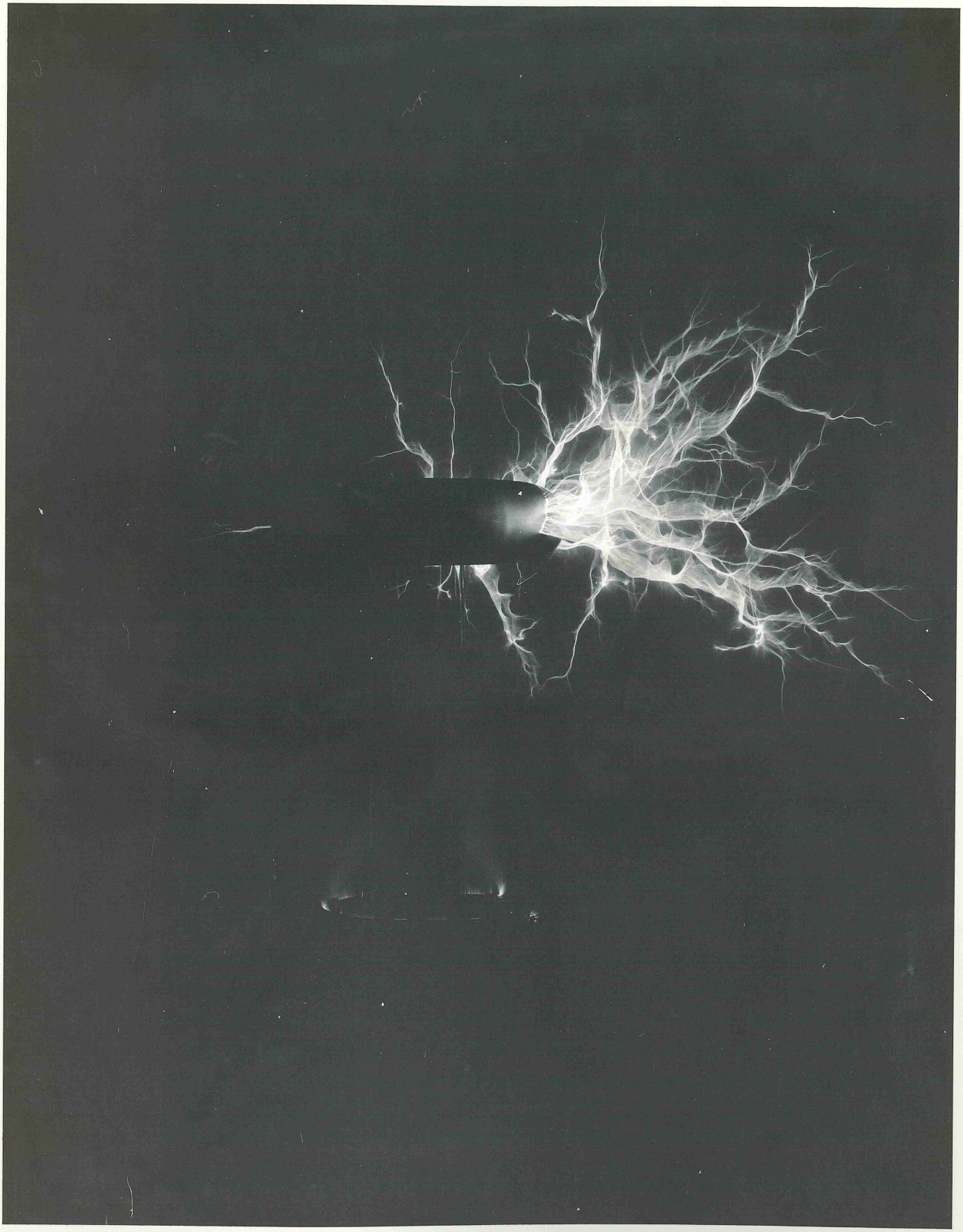
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

DAN PERKINS

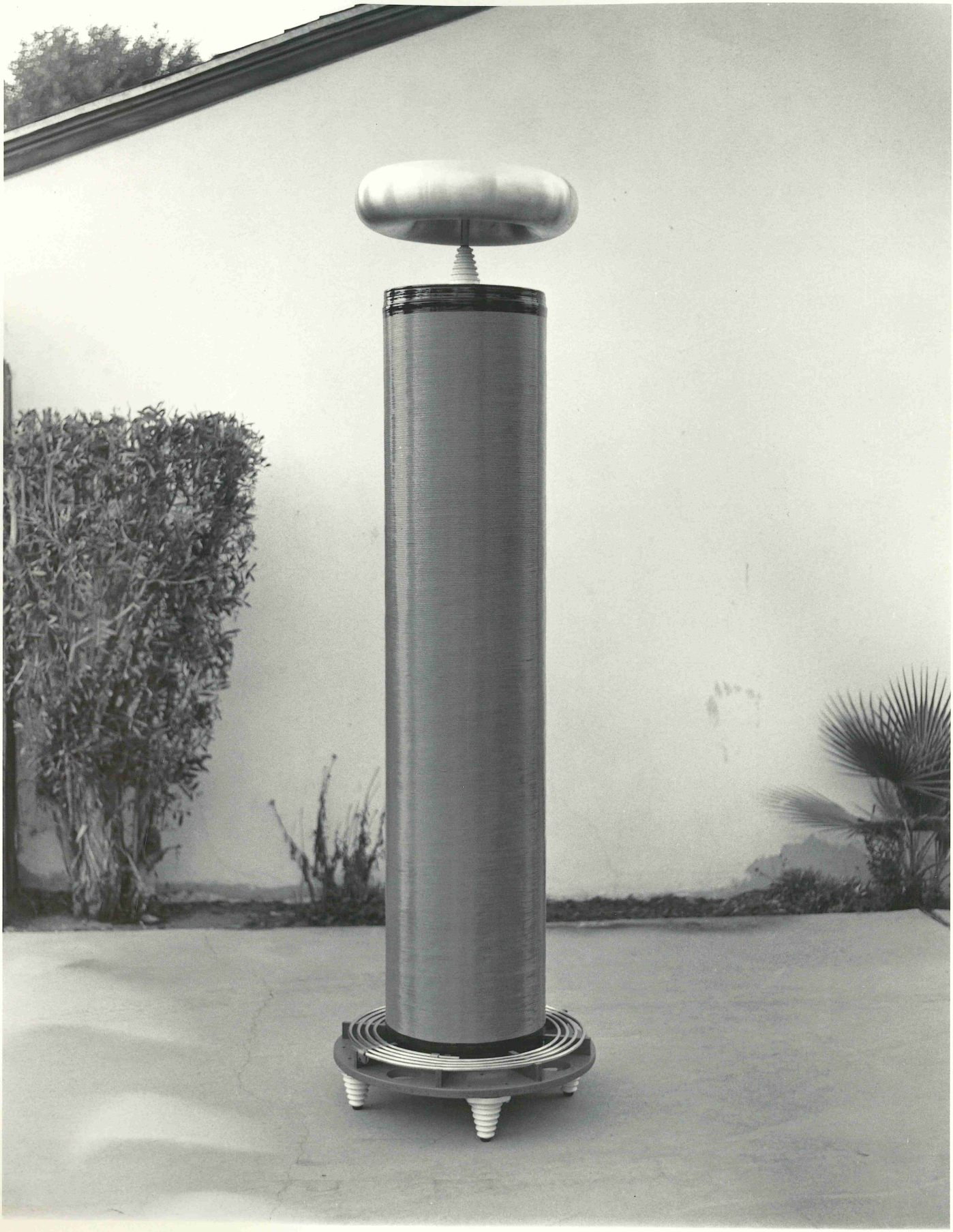
MODEL 8 1/2

B & W'S

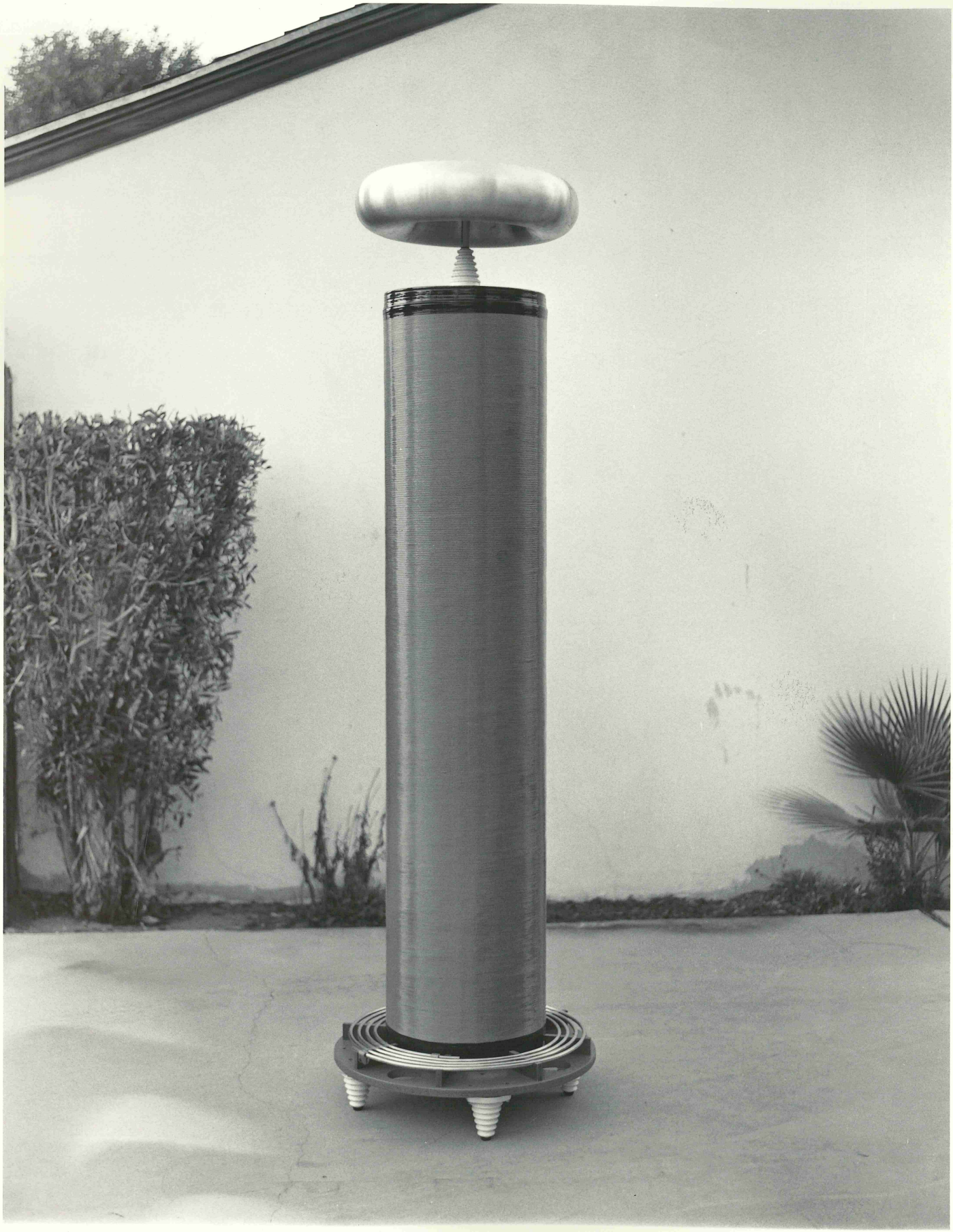
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



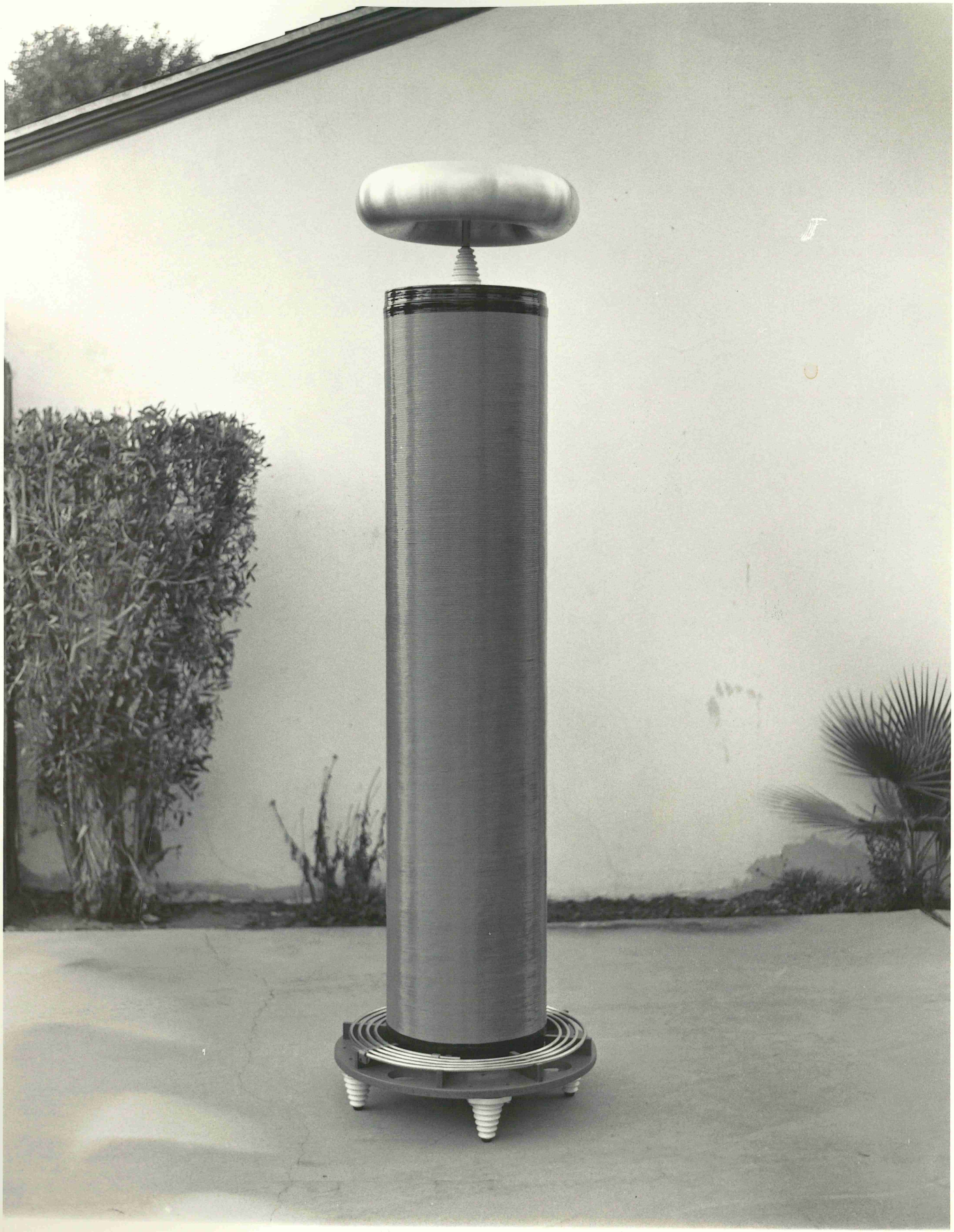
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



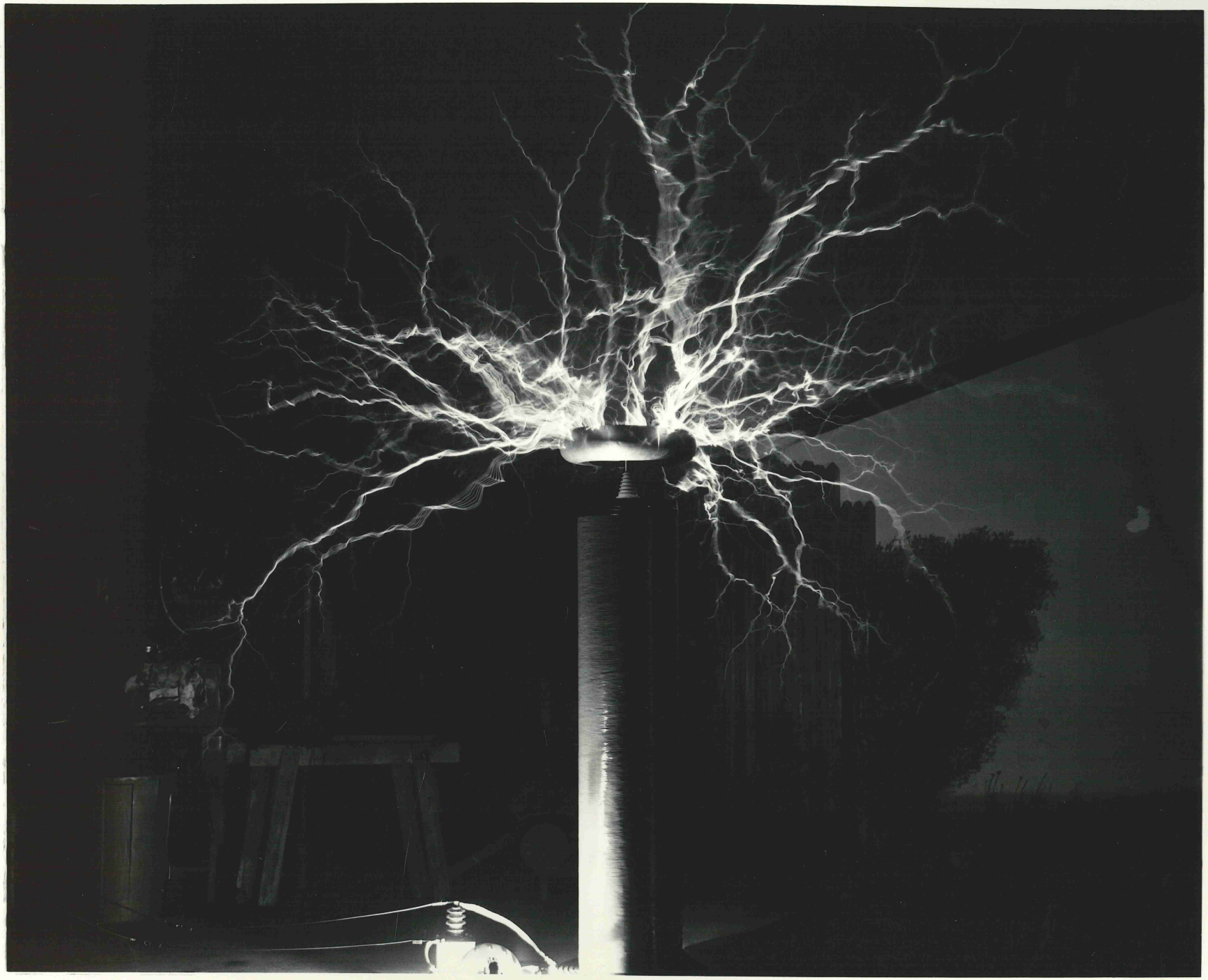
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



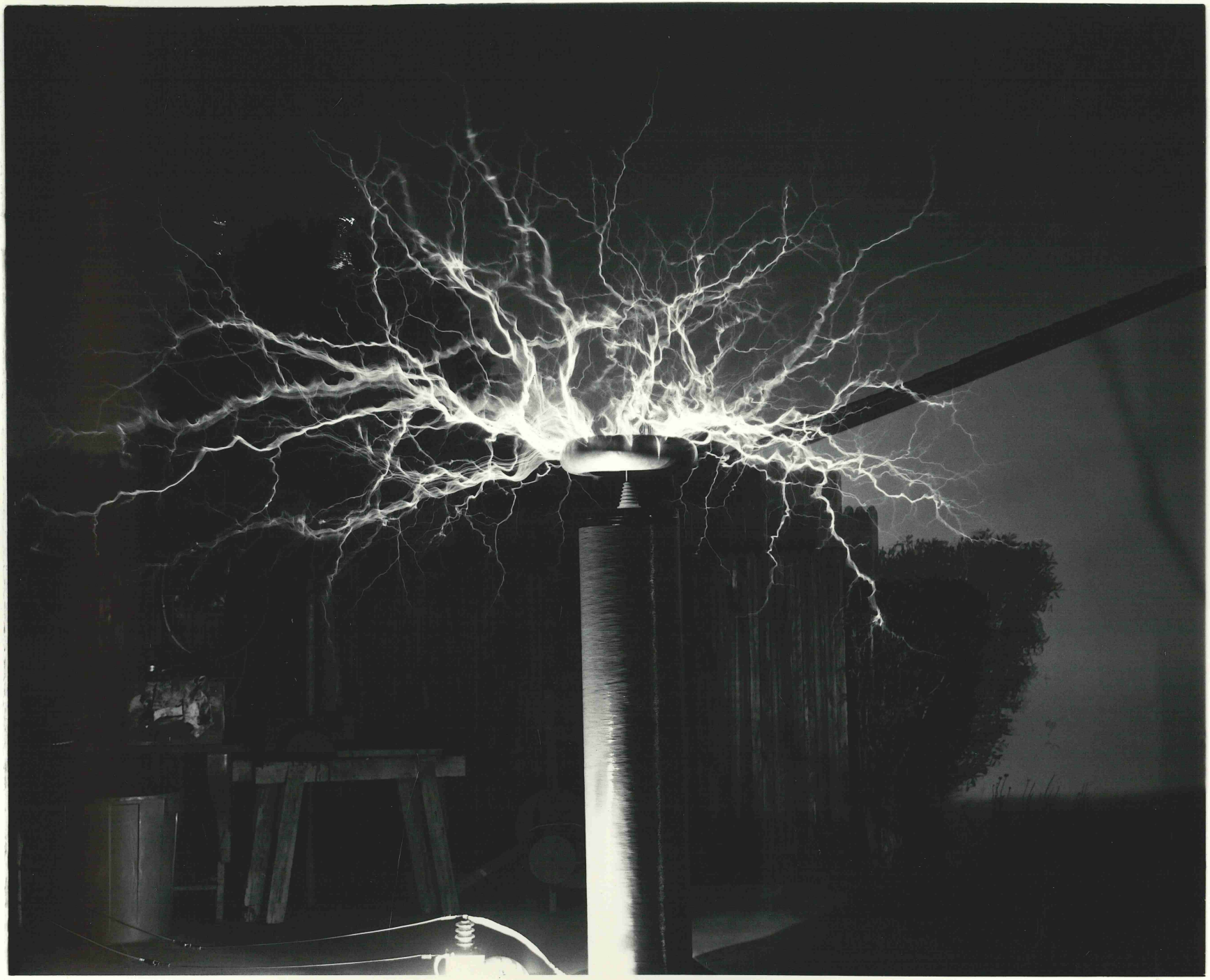
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

SUPER MODEL 9
+ POWER SUPPLY

B & W 'S

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



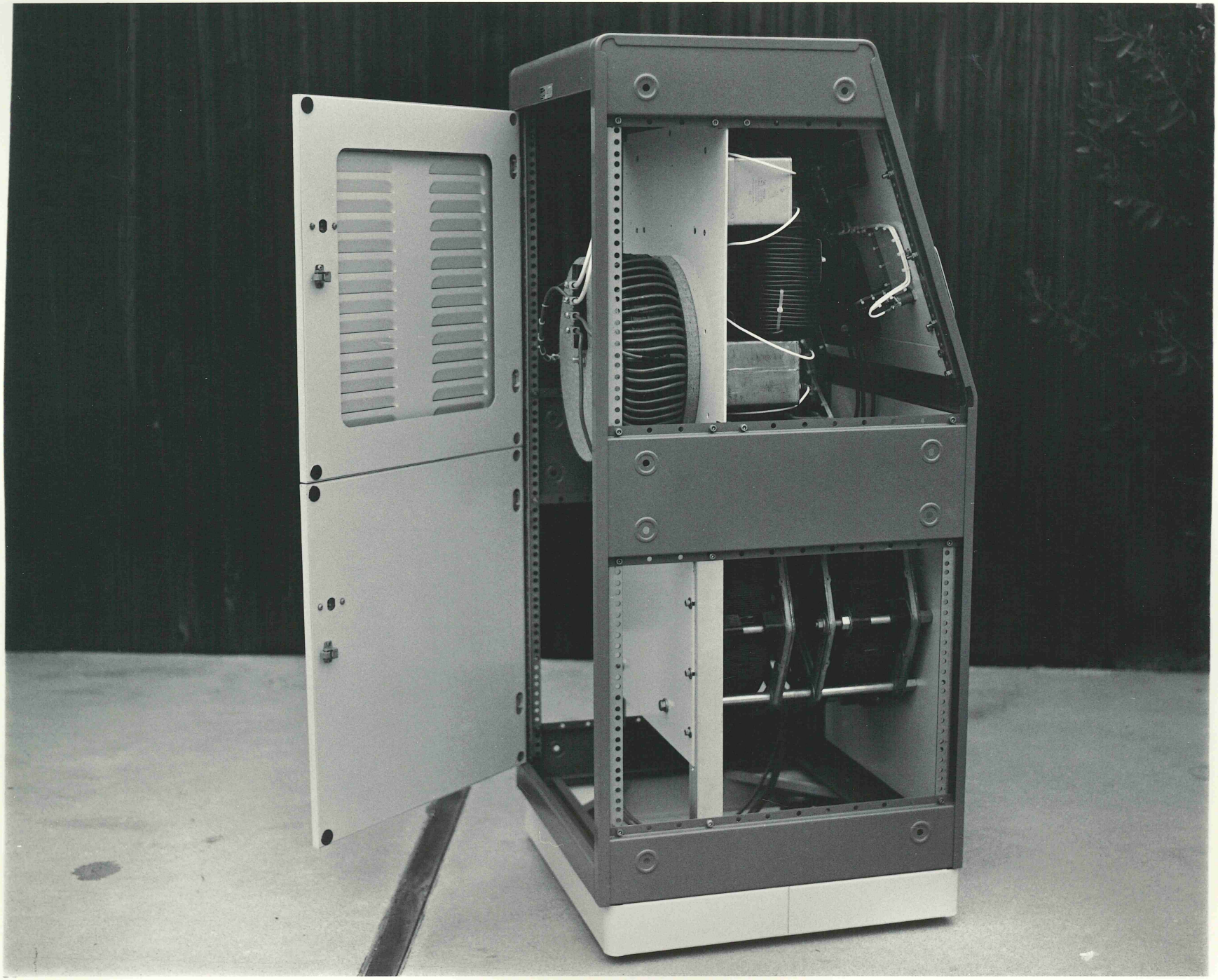
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



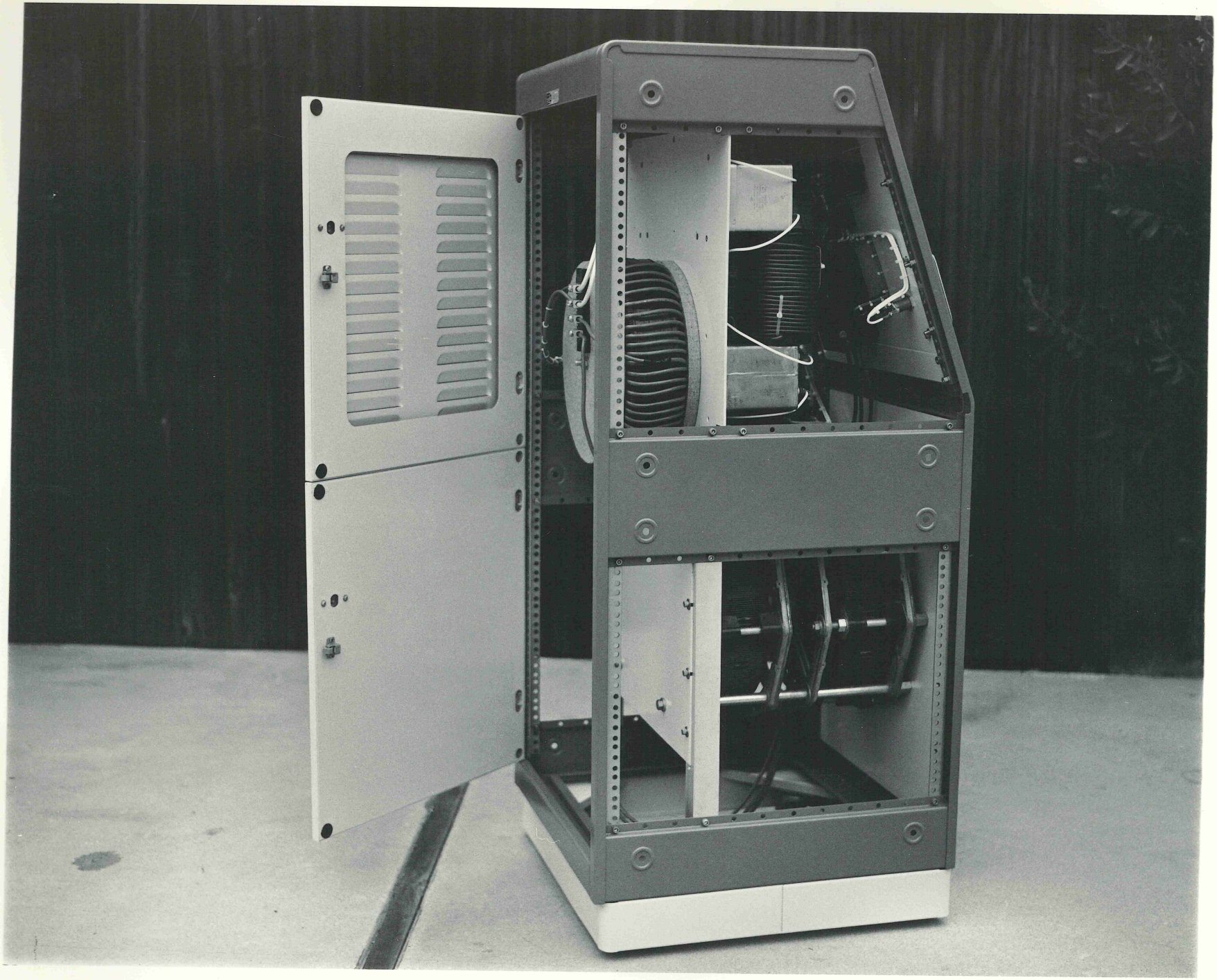
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



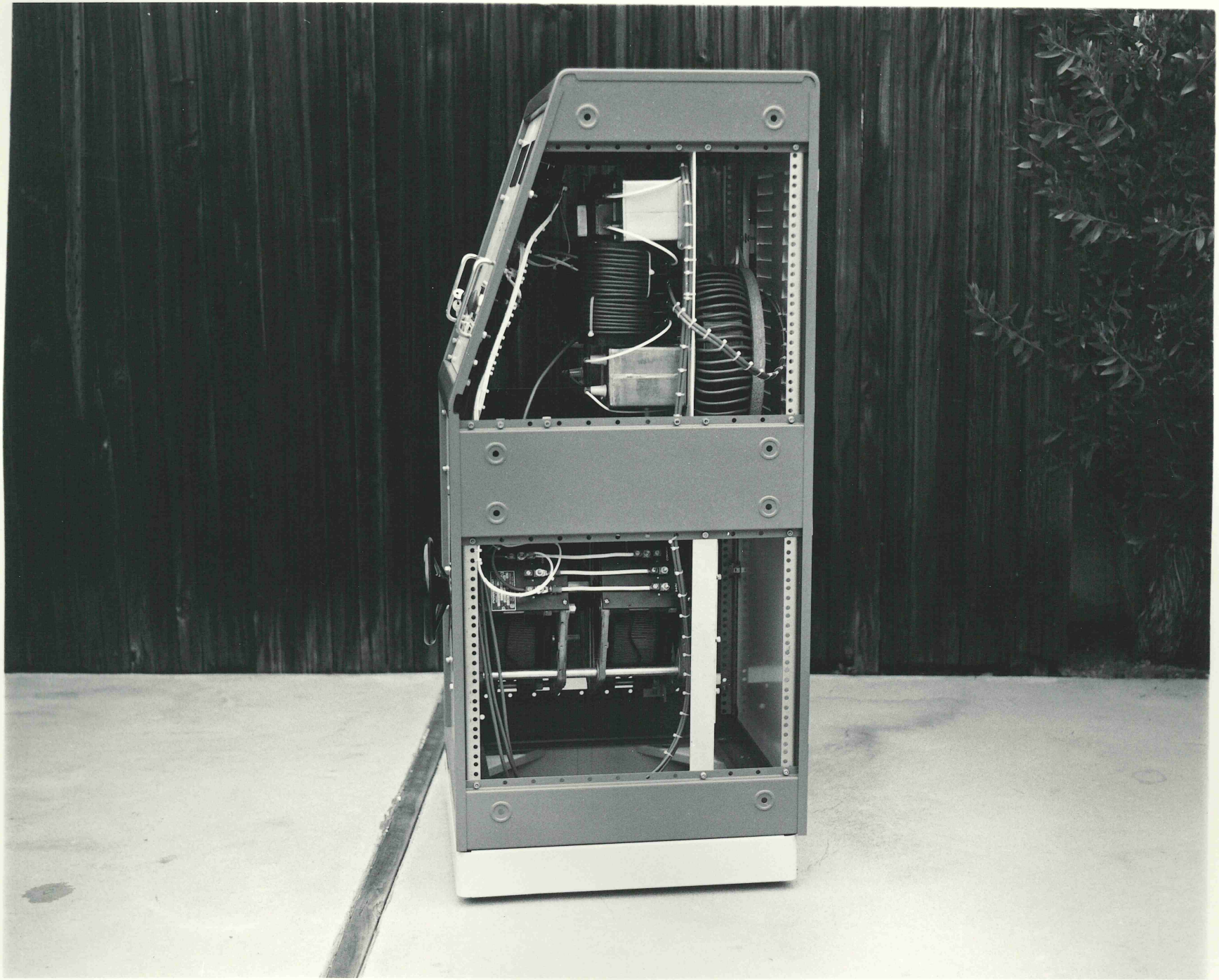
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



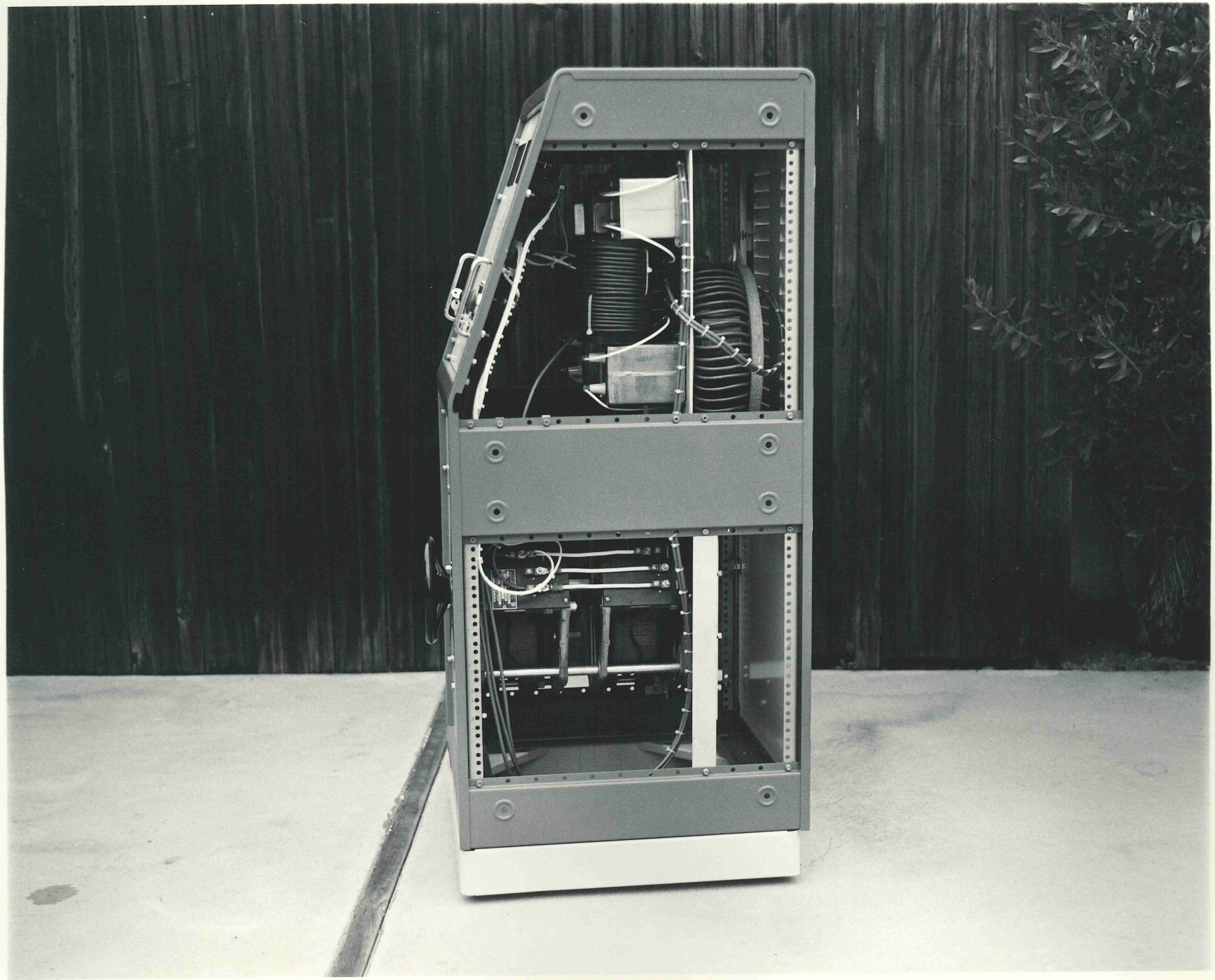
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



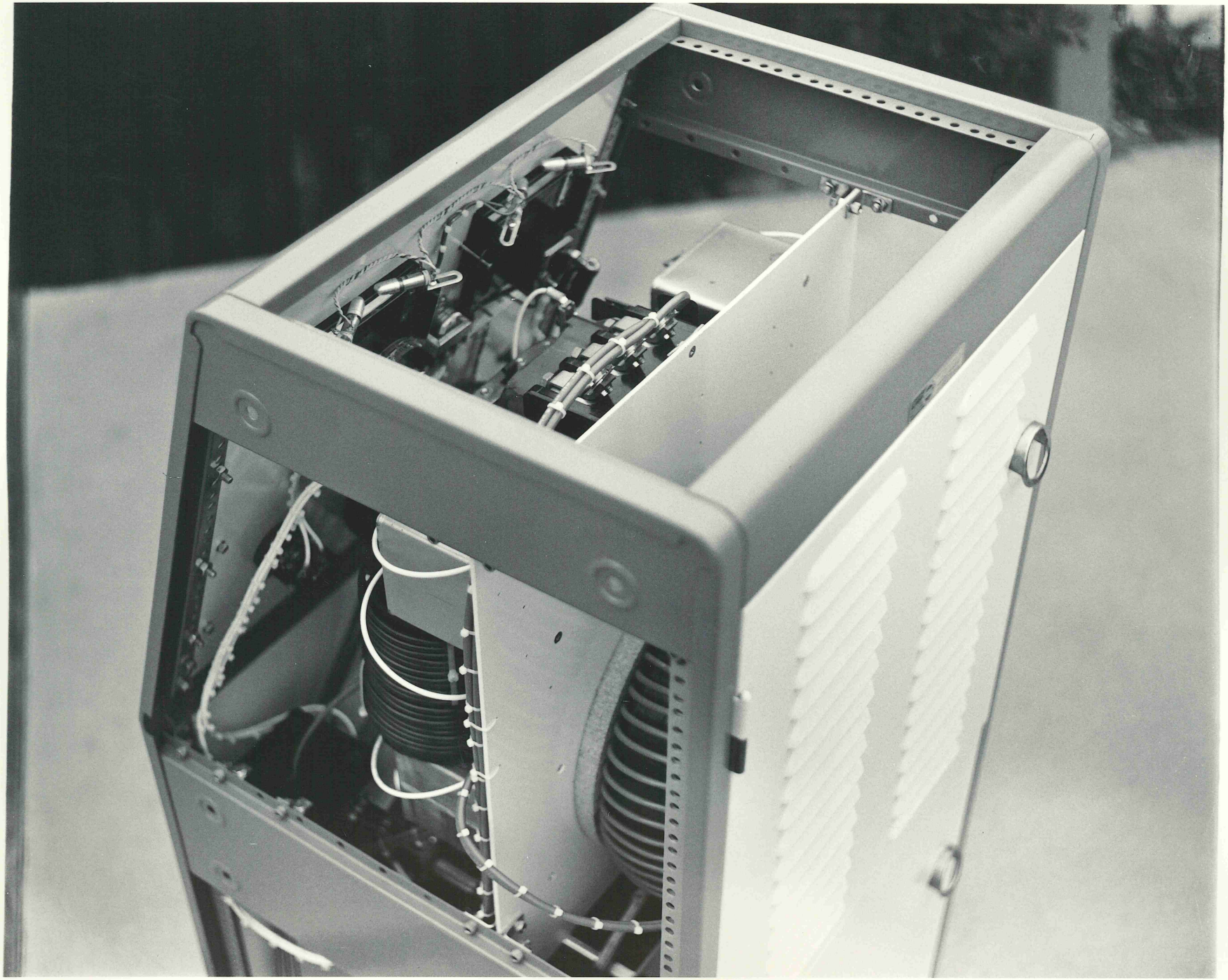
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



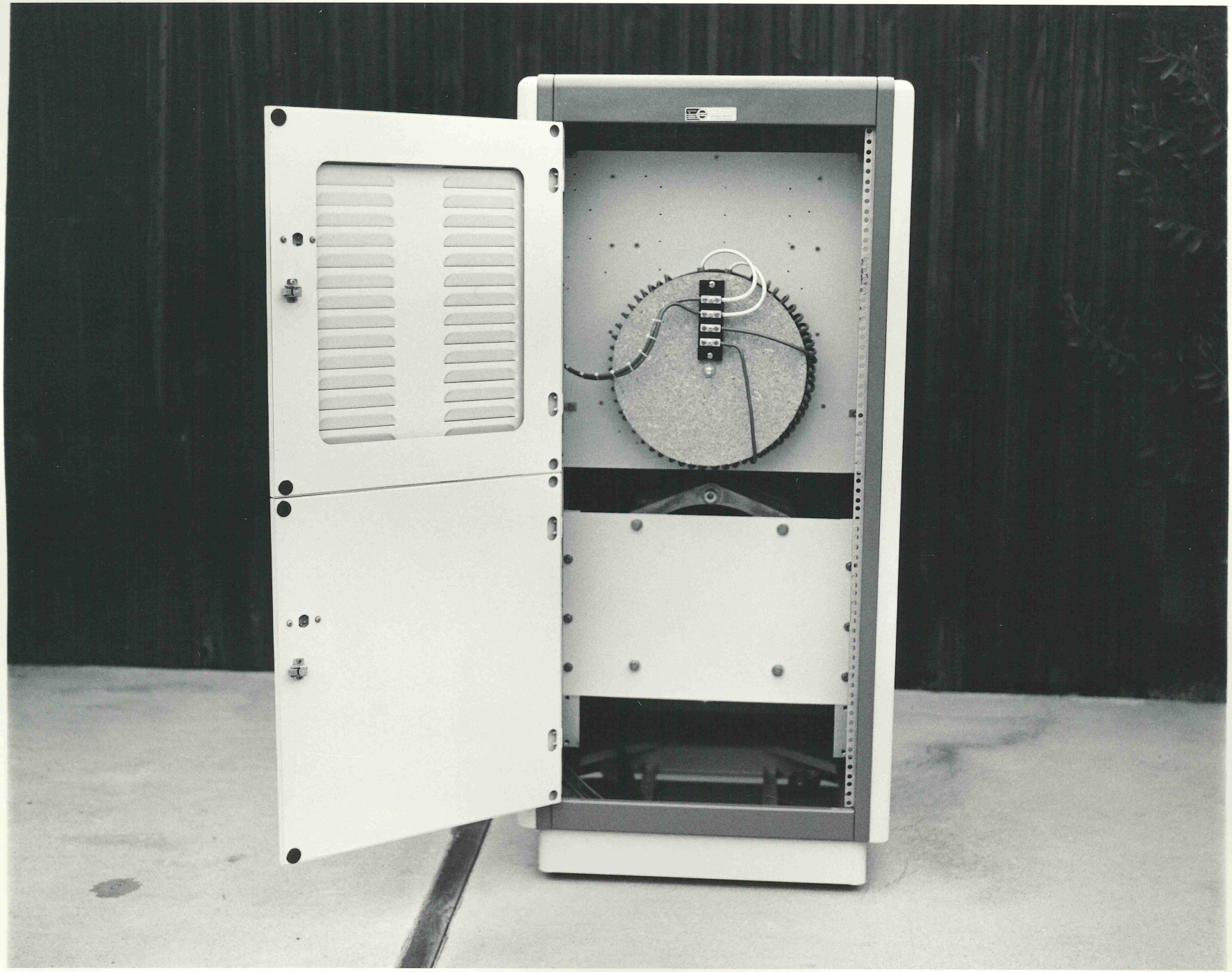
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



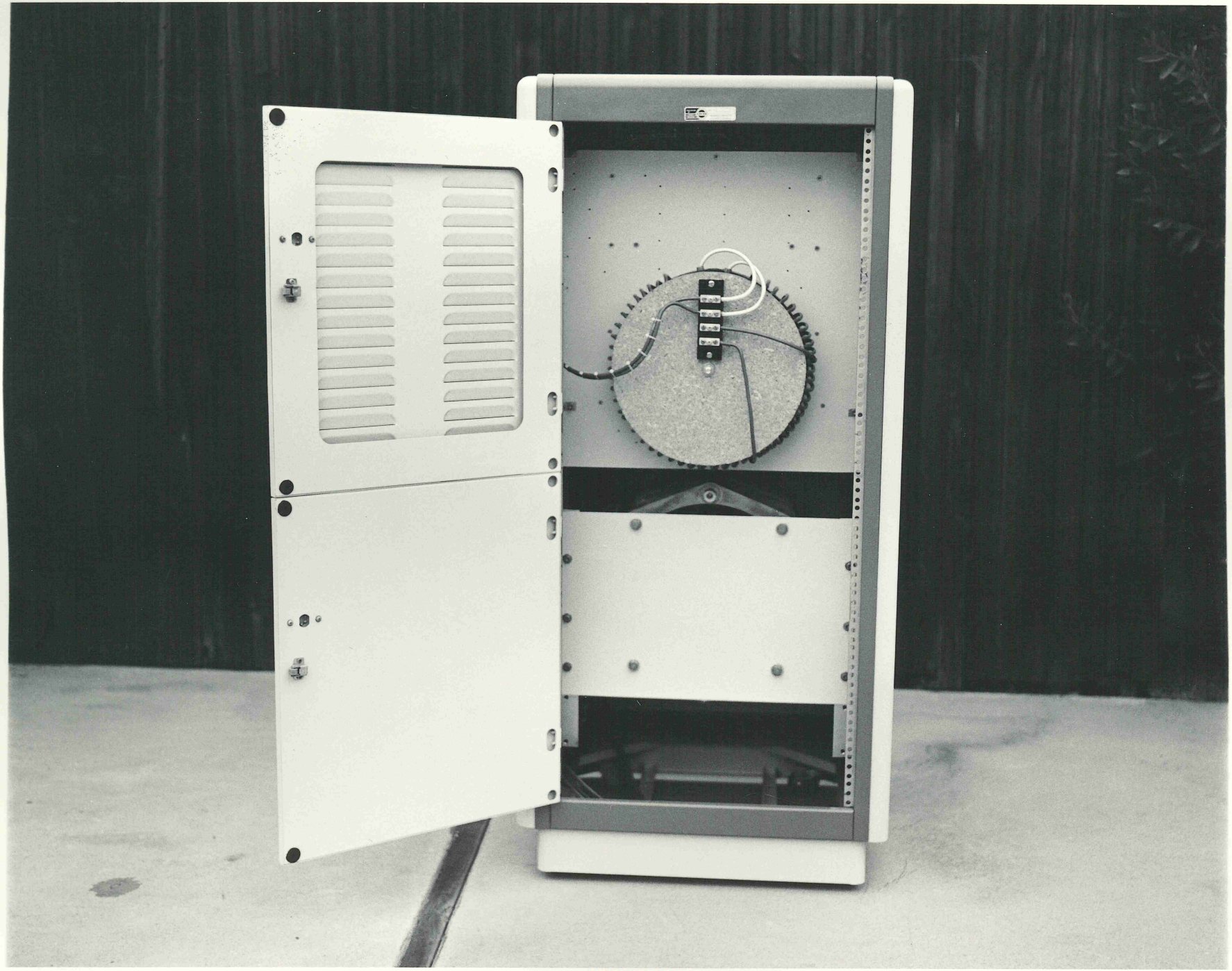
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

DELUX PWR. SUPPLY

SNOOT DOWN 50%

FEB '82

PHOTO 1H

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



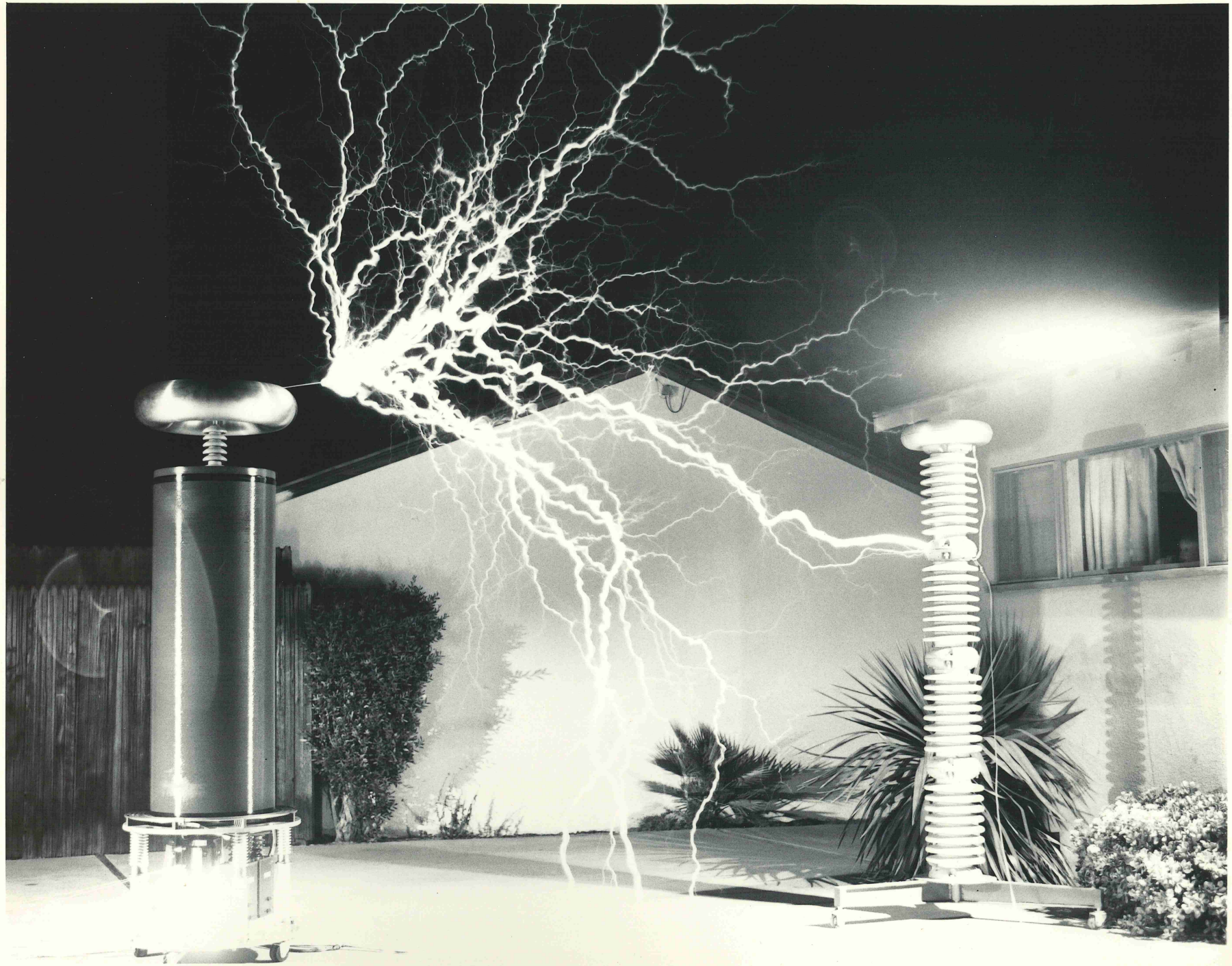
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



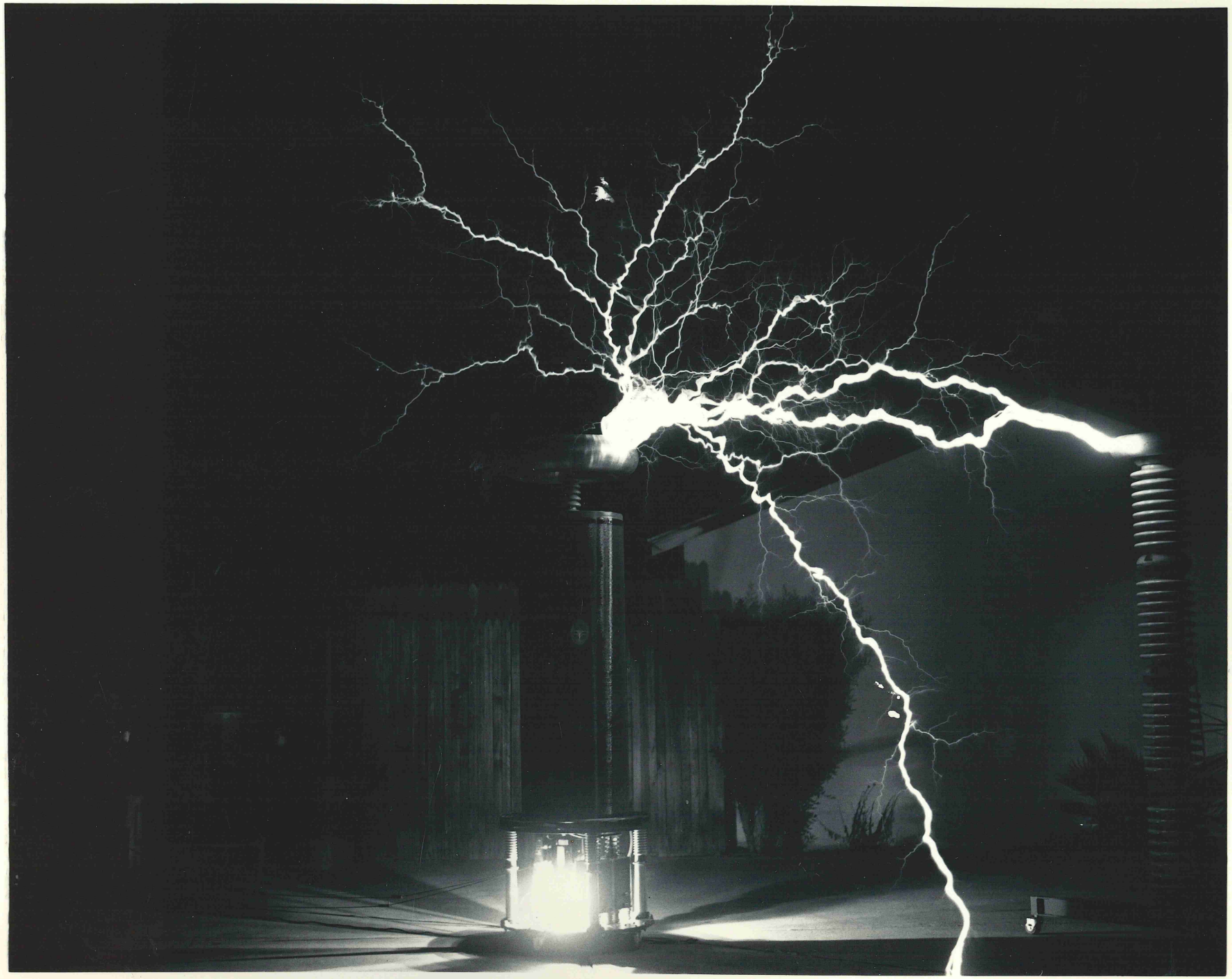
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



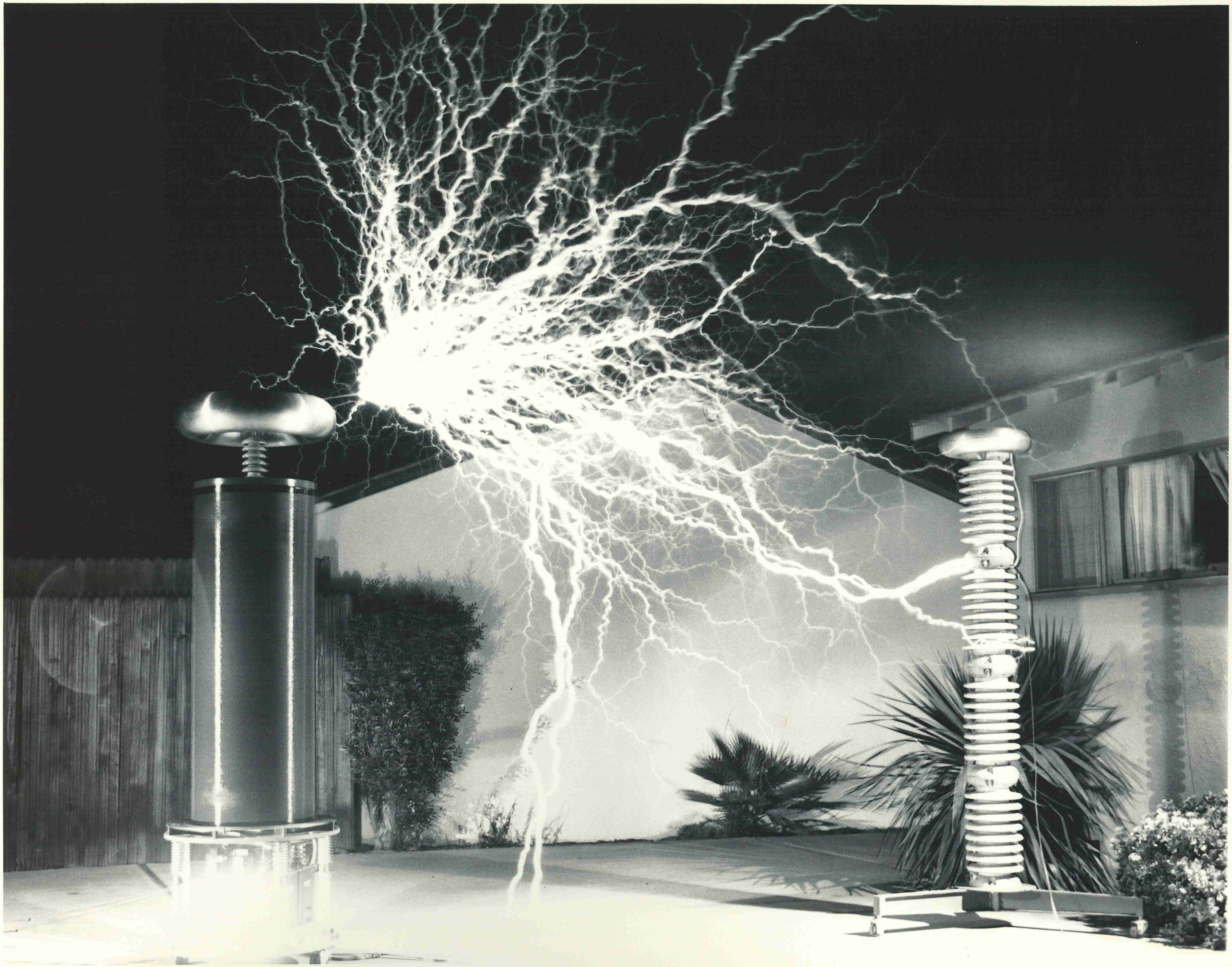
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



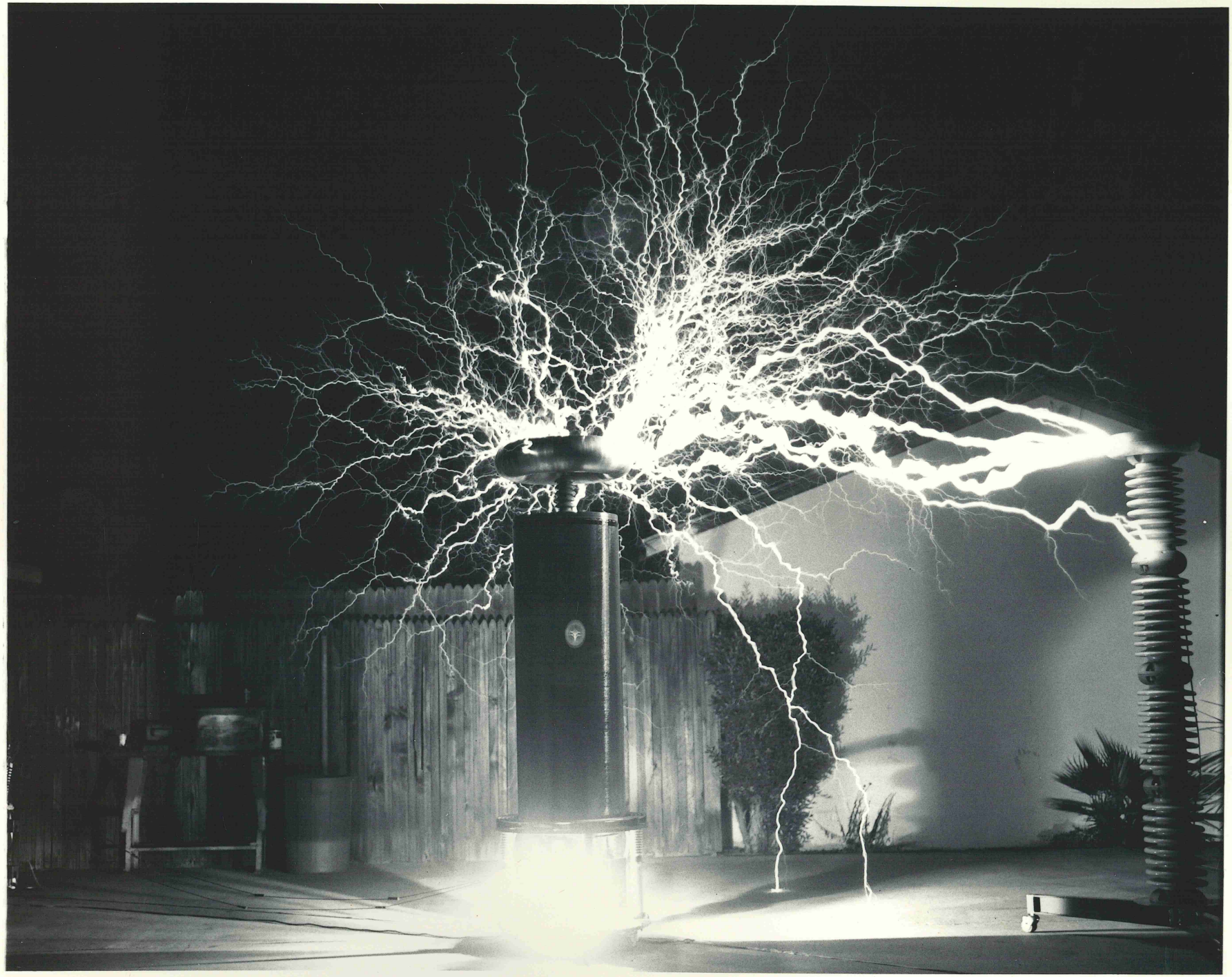
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



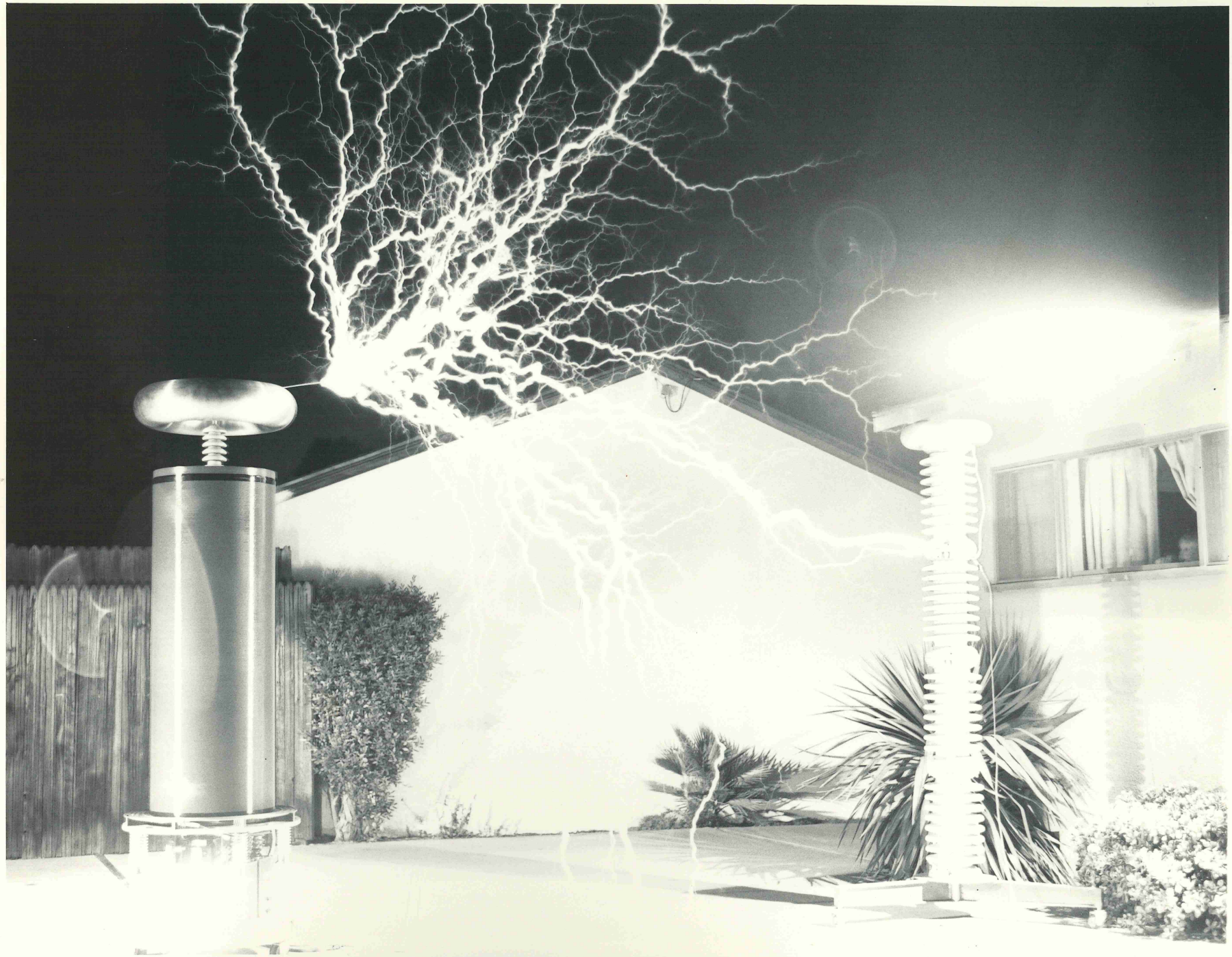
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



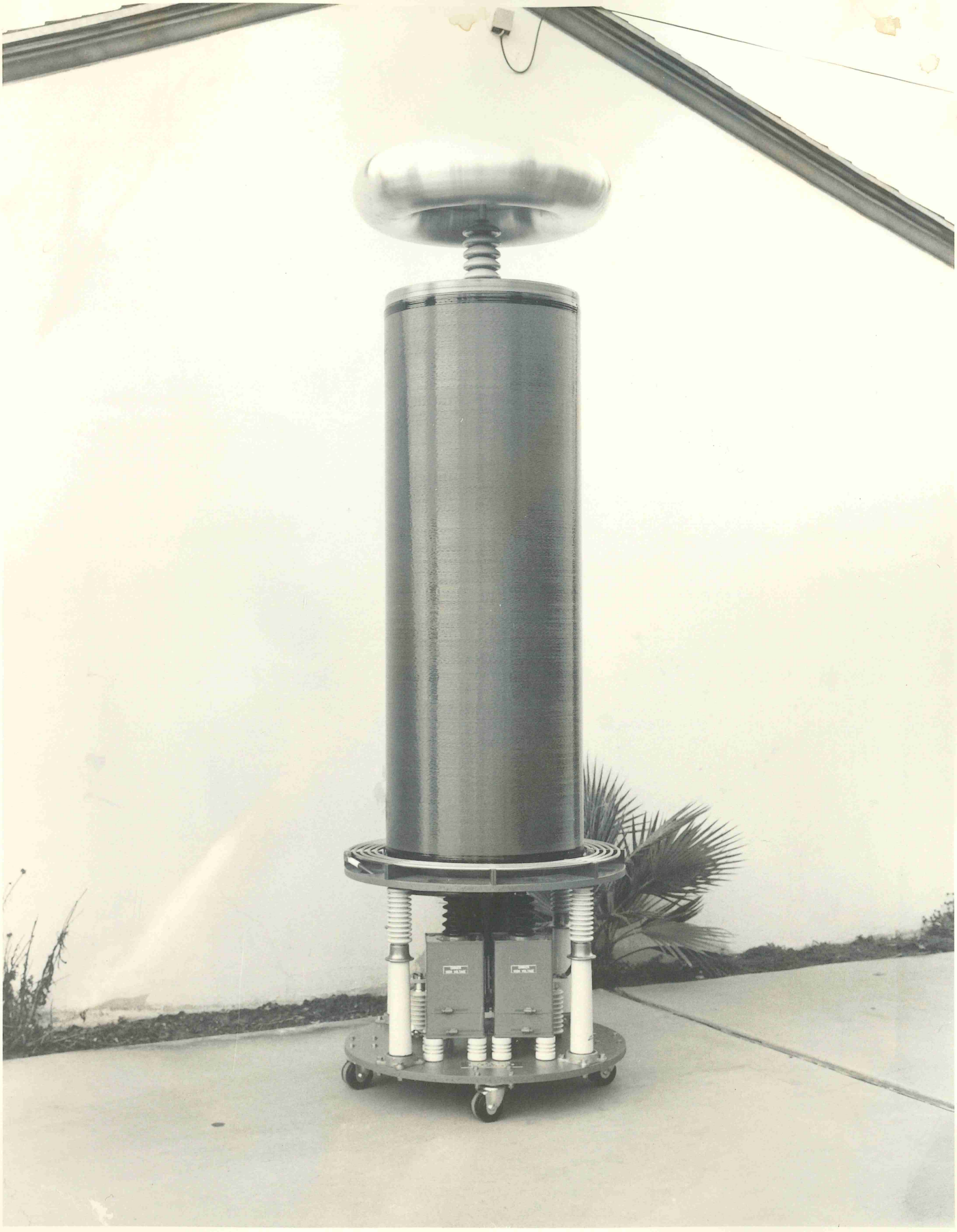
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



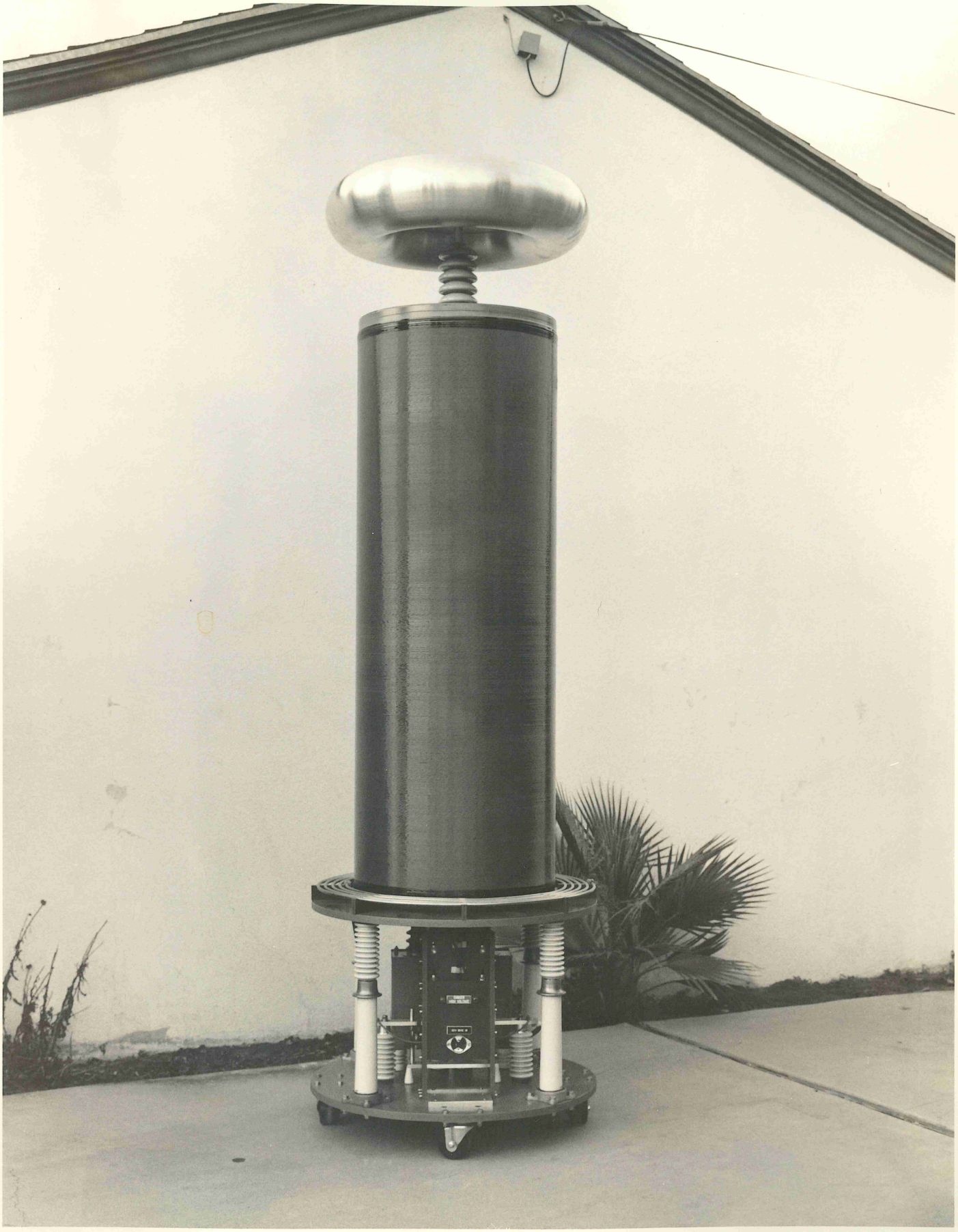
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



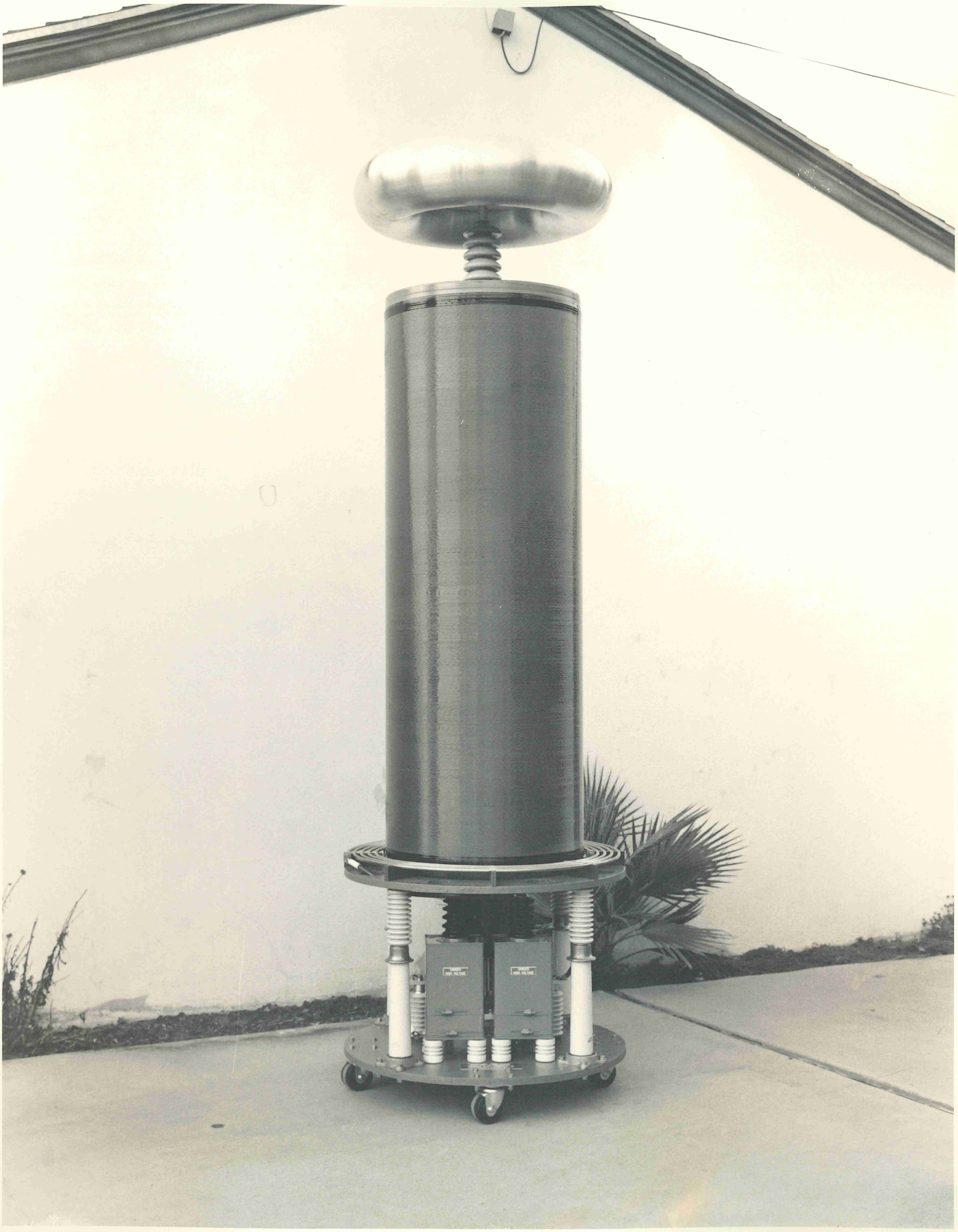
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



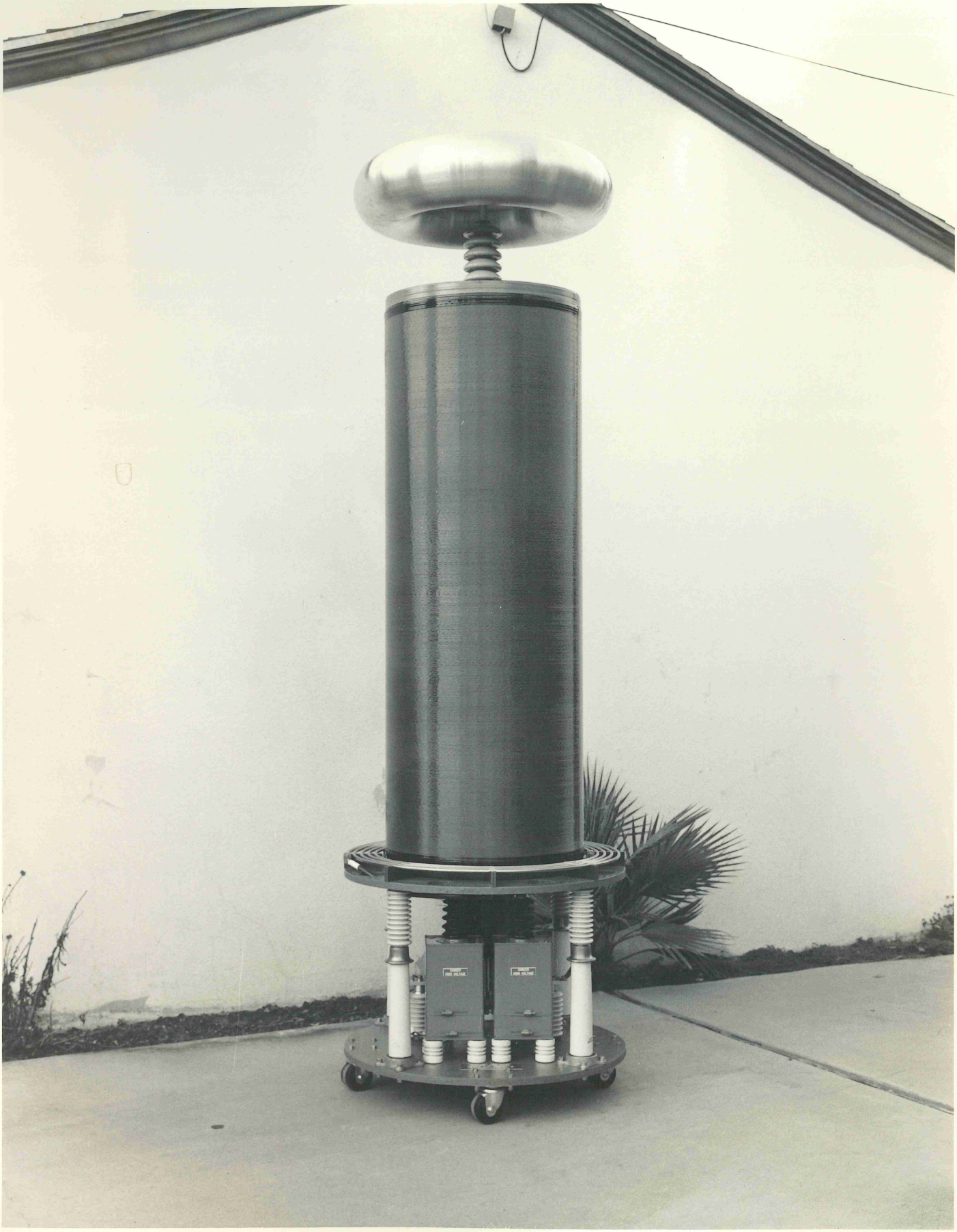
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



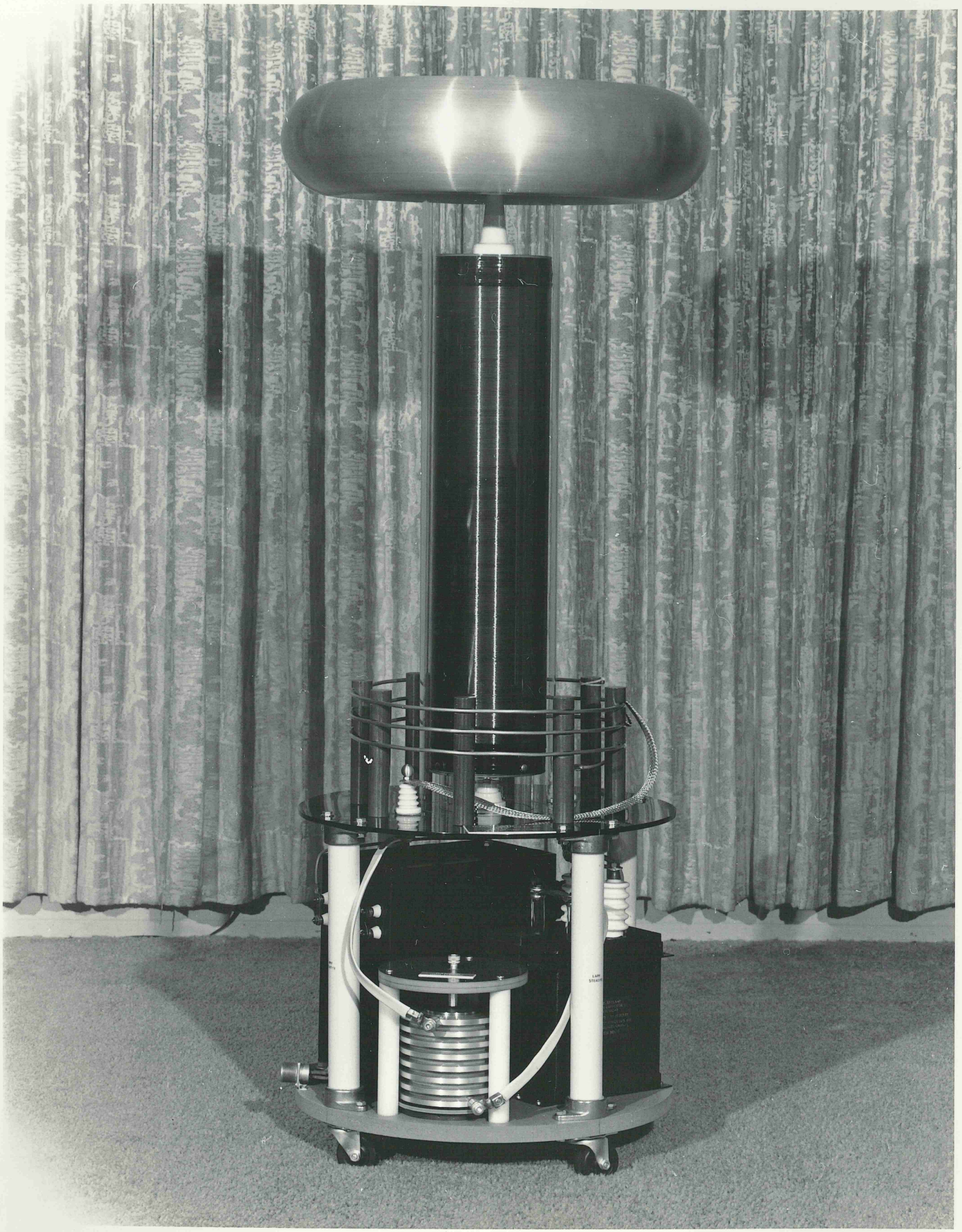
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



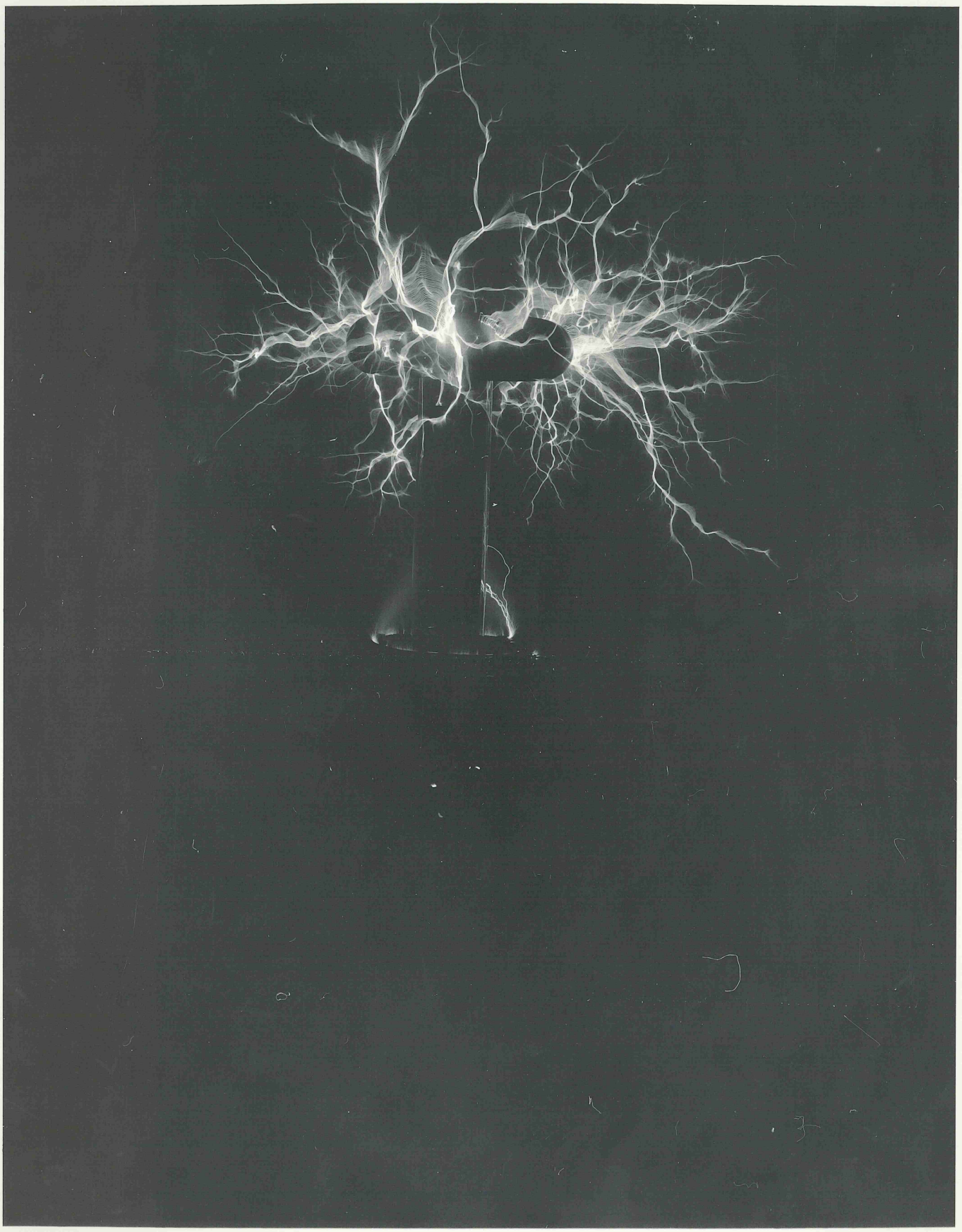
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

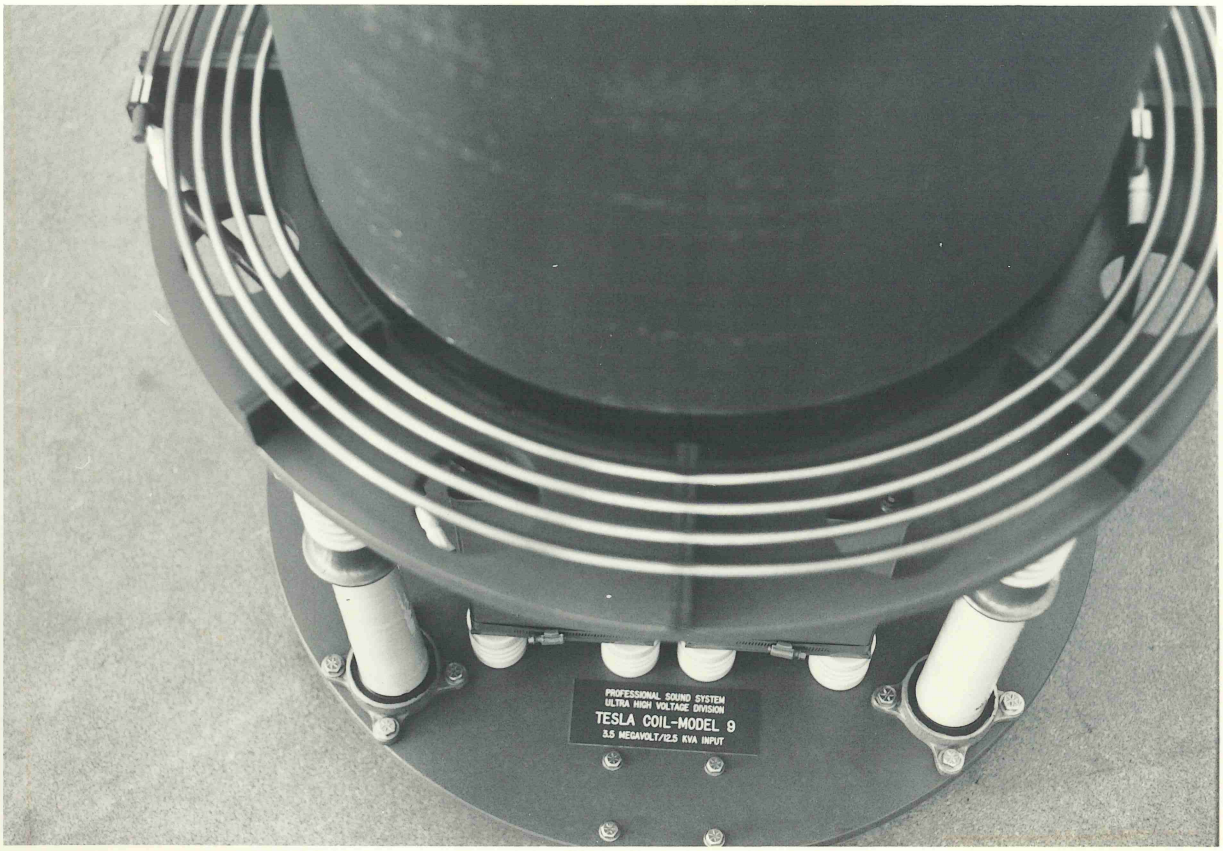


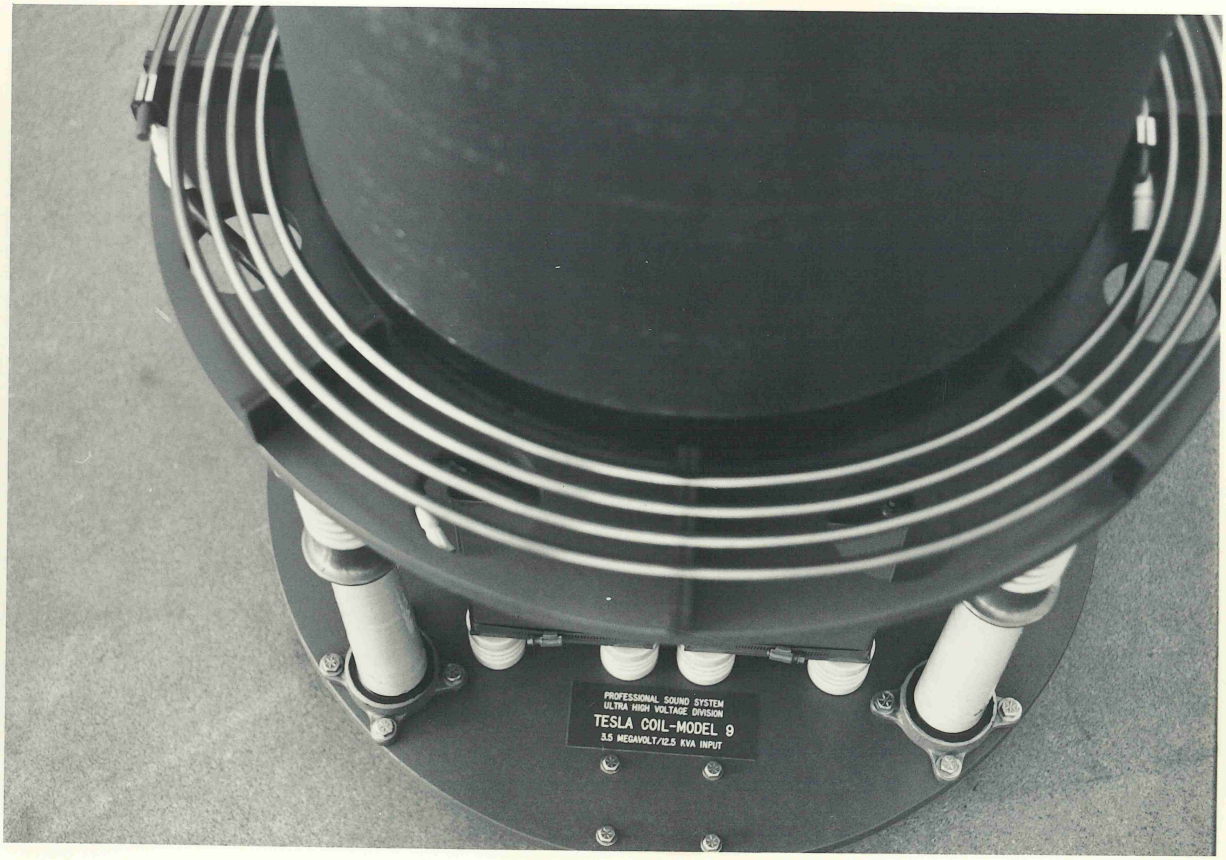
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



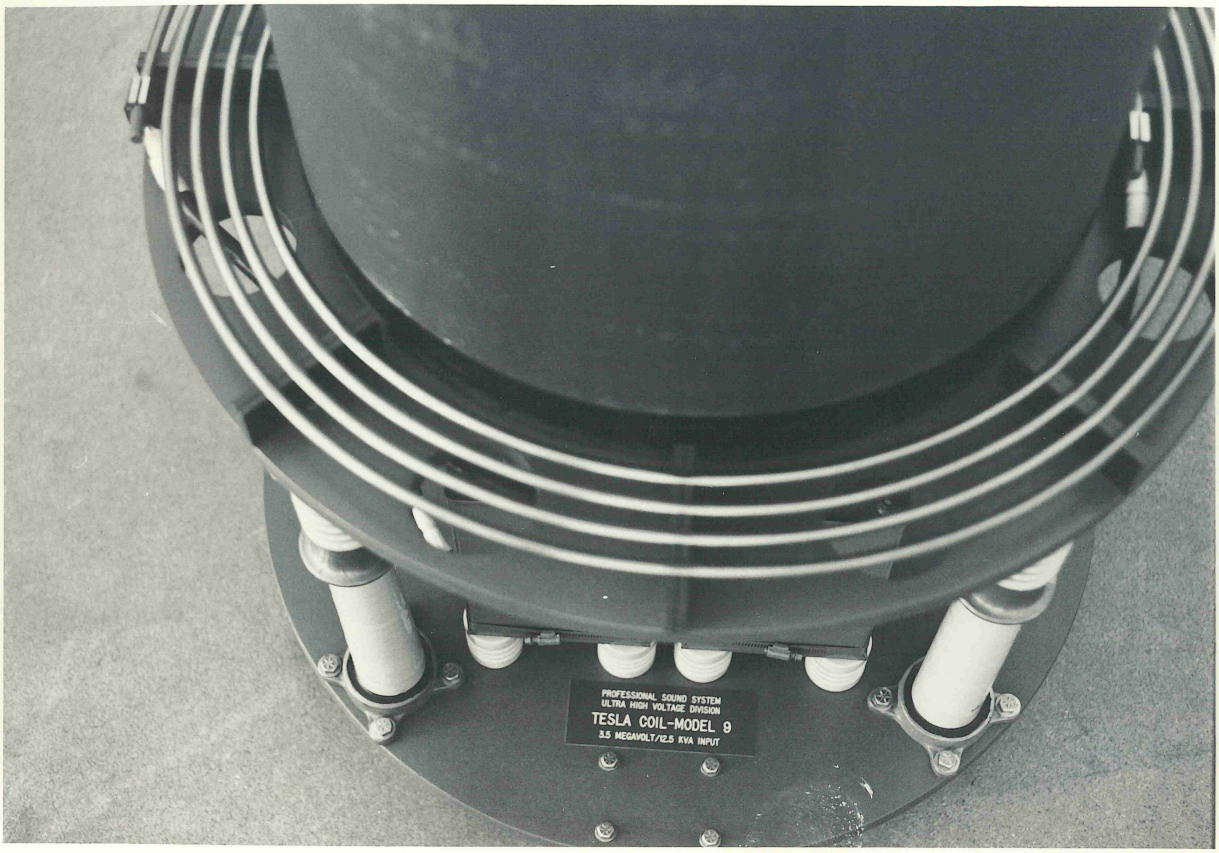


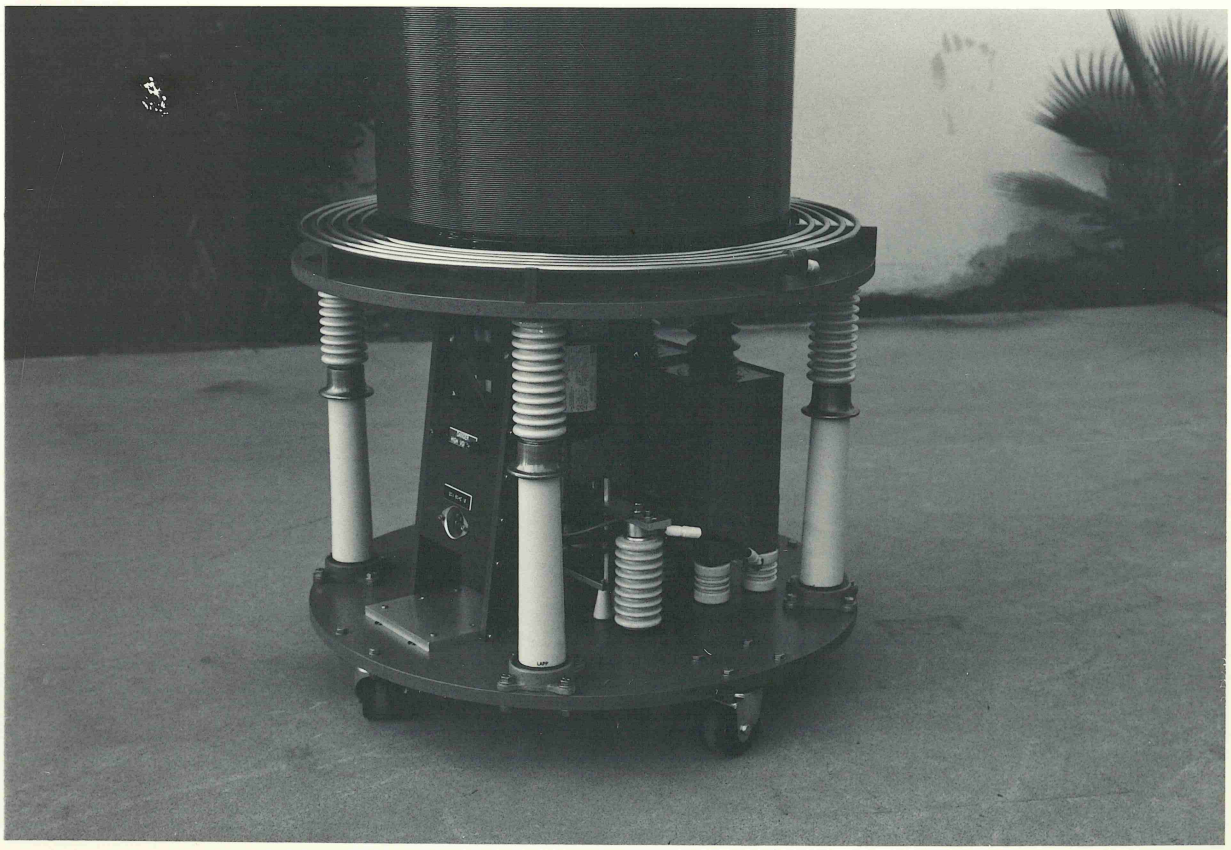
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





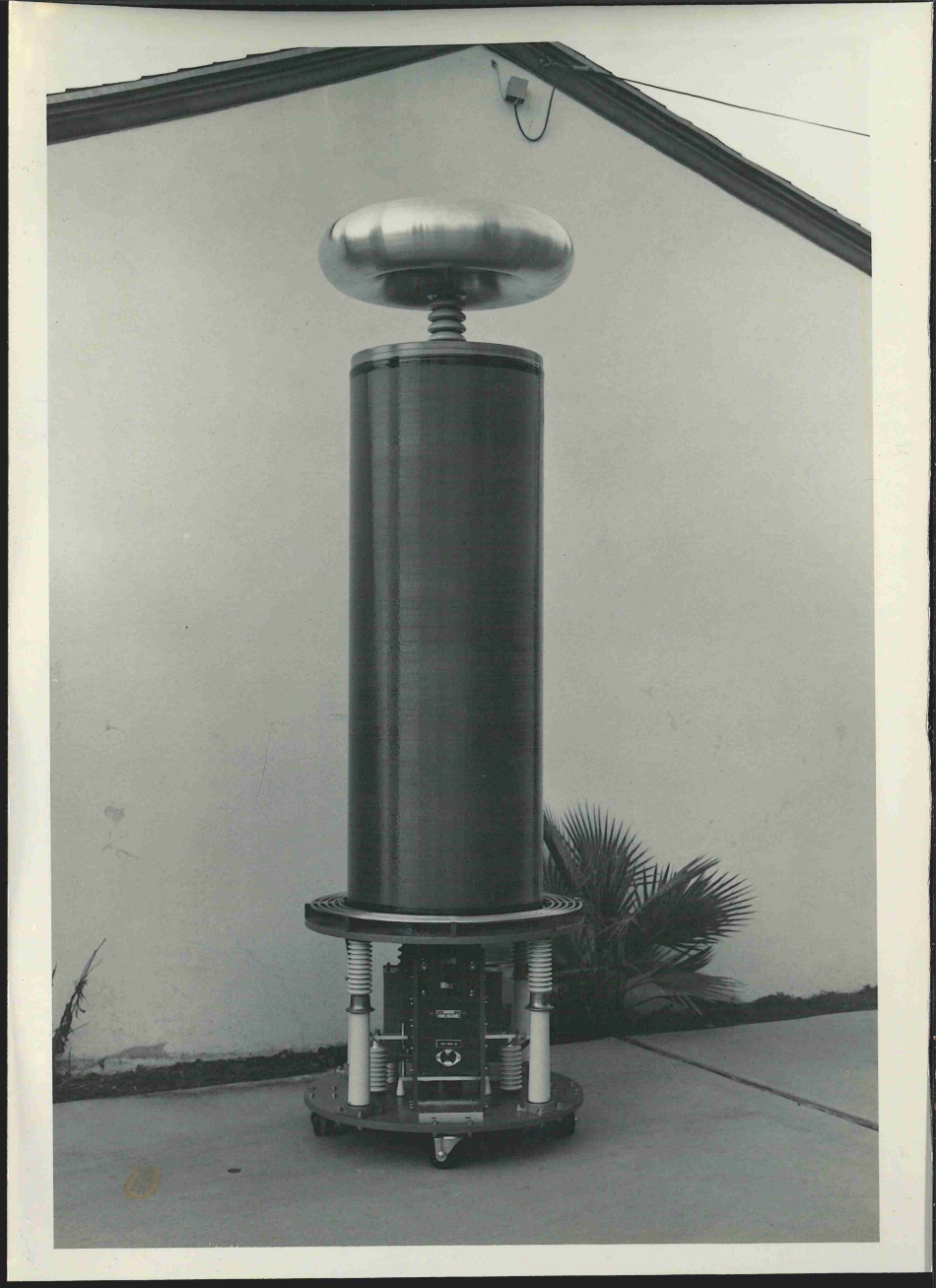
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



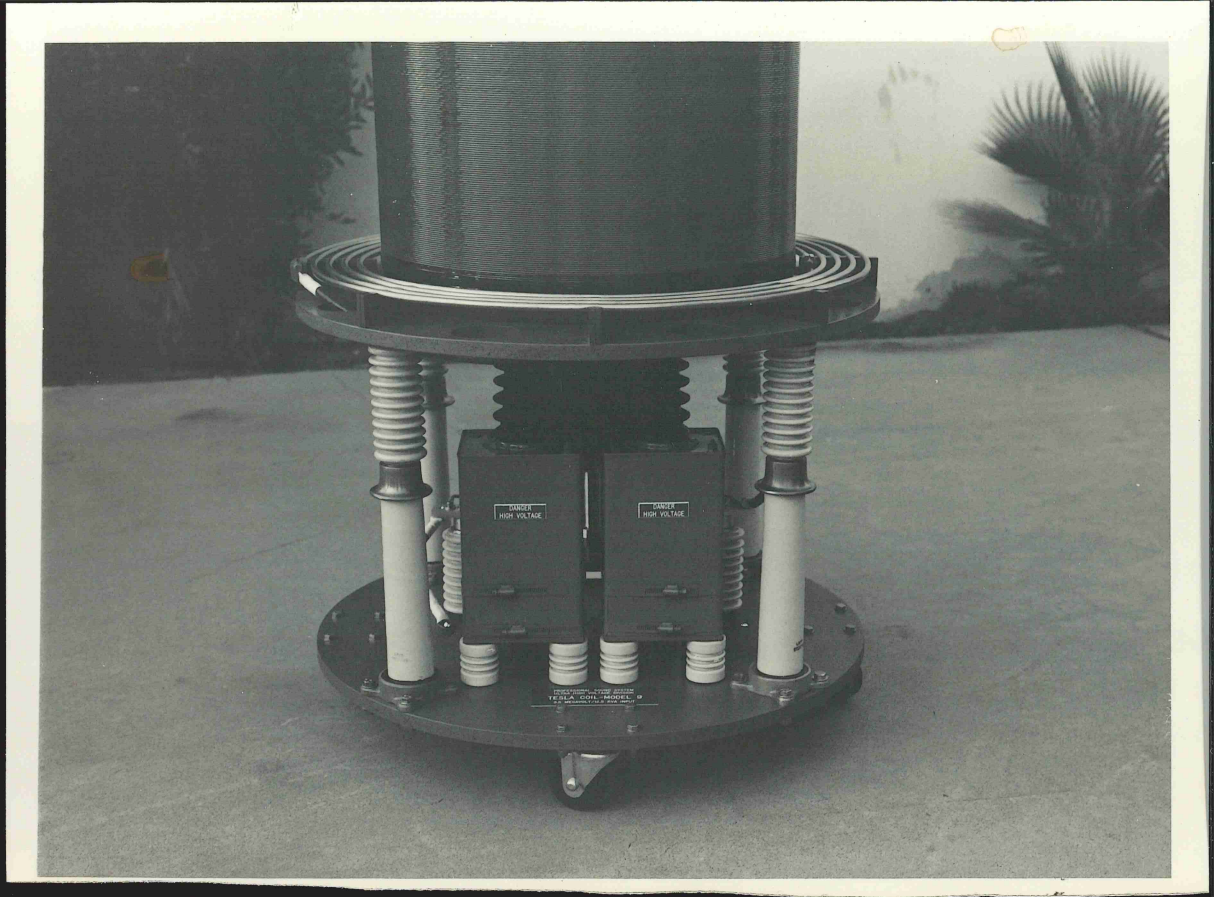
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

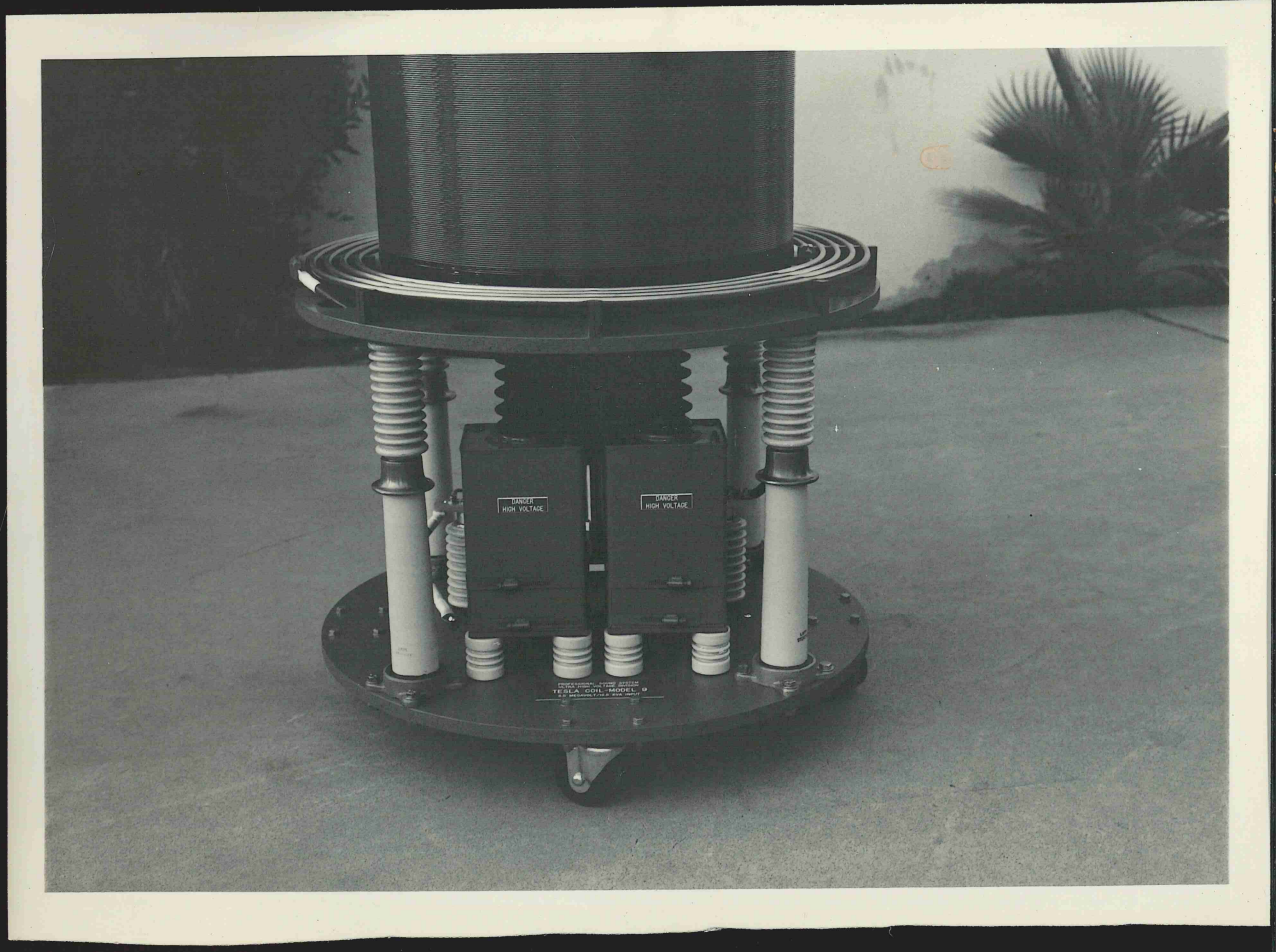


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

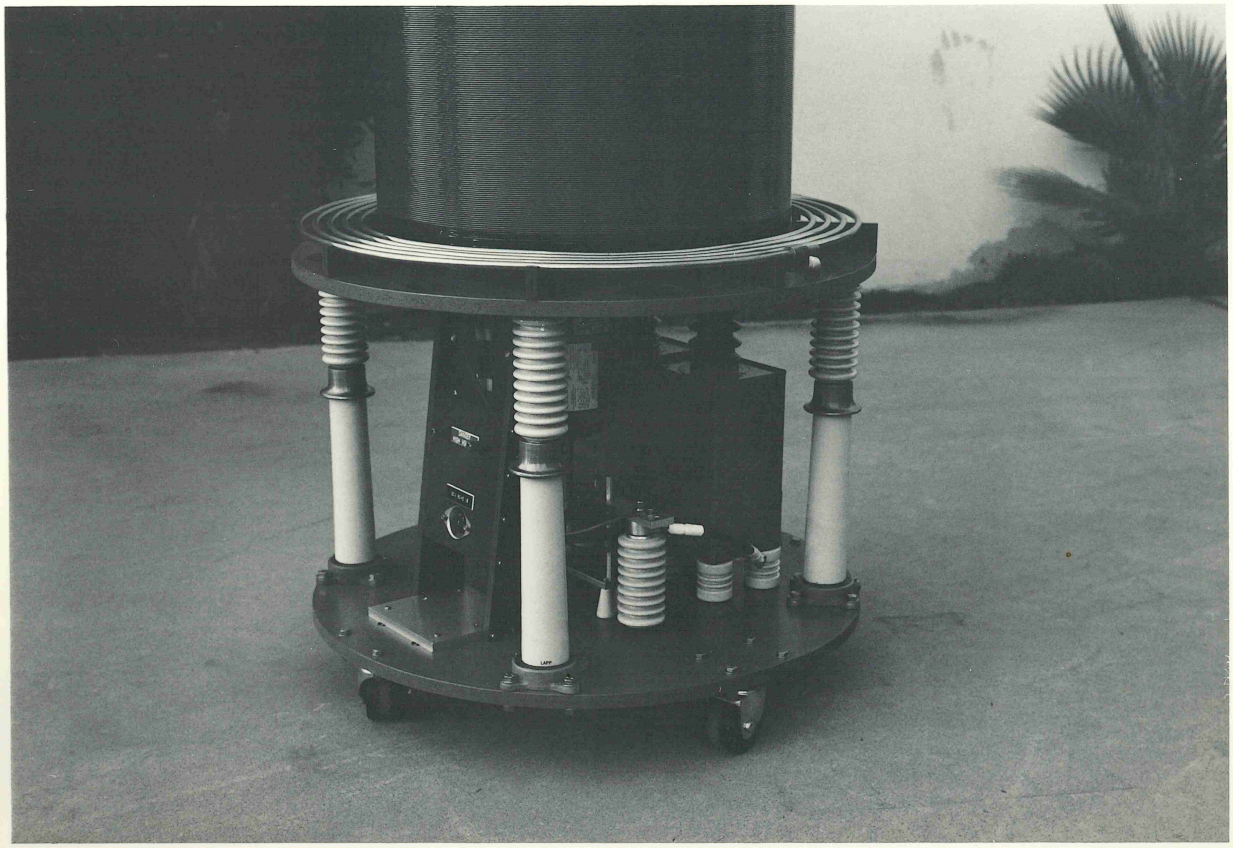


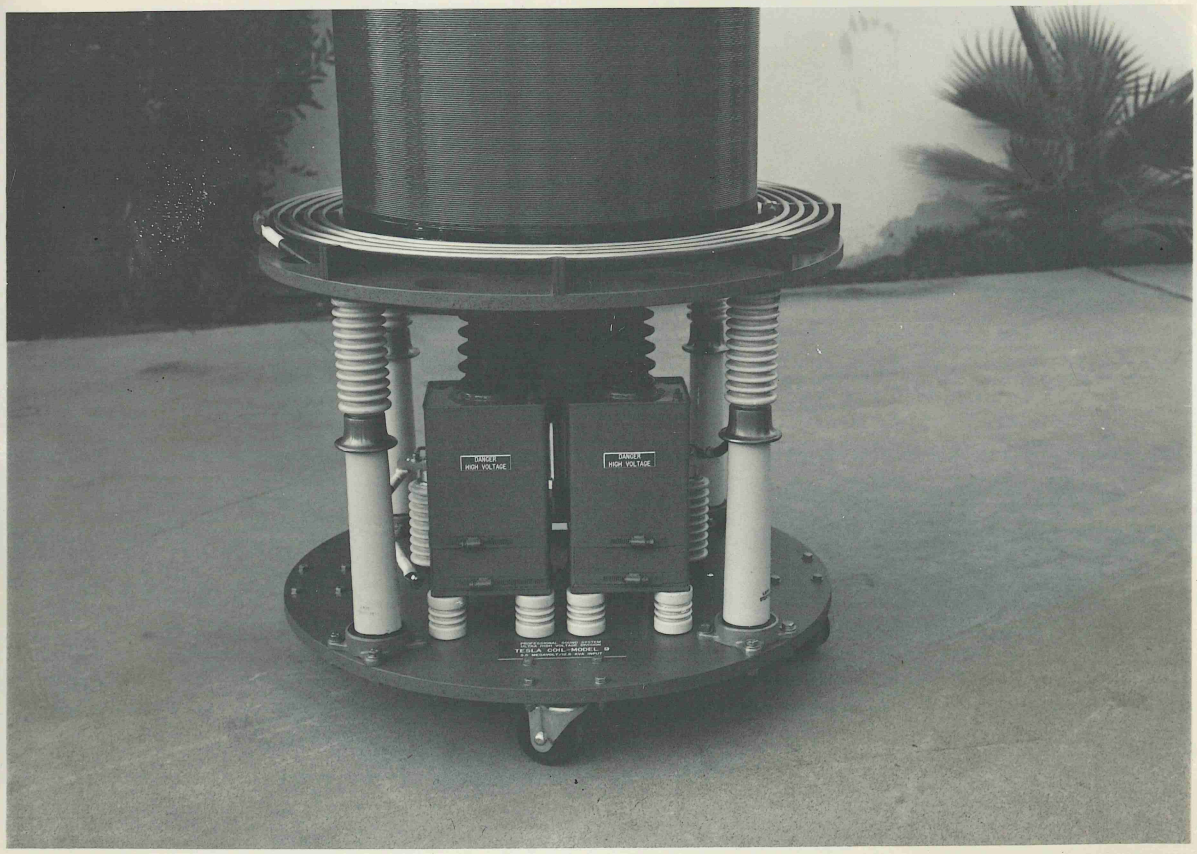
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





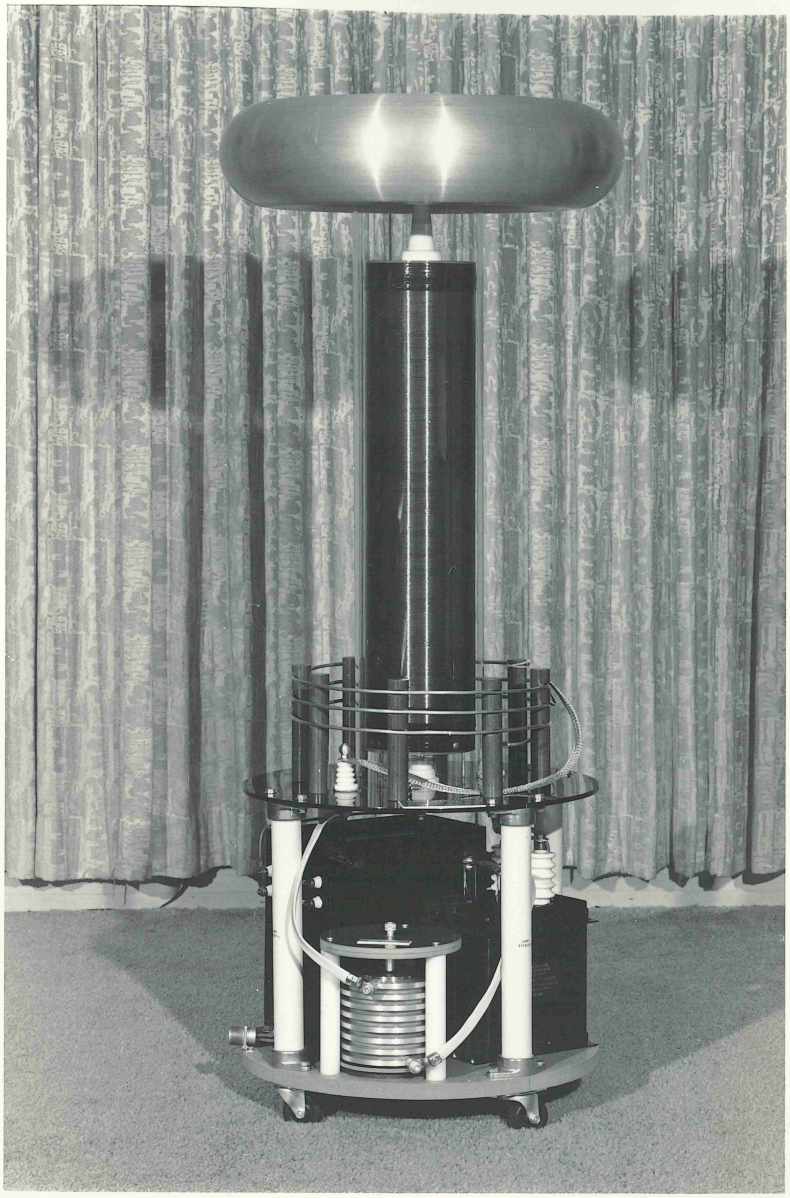
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



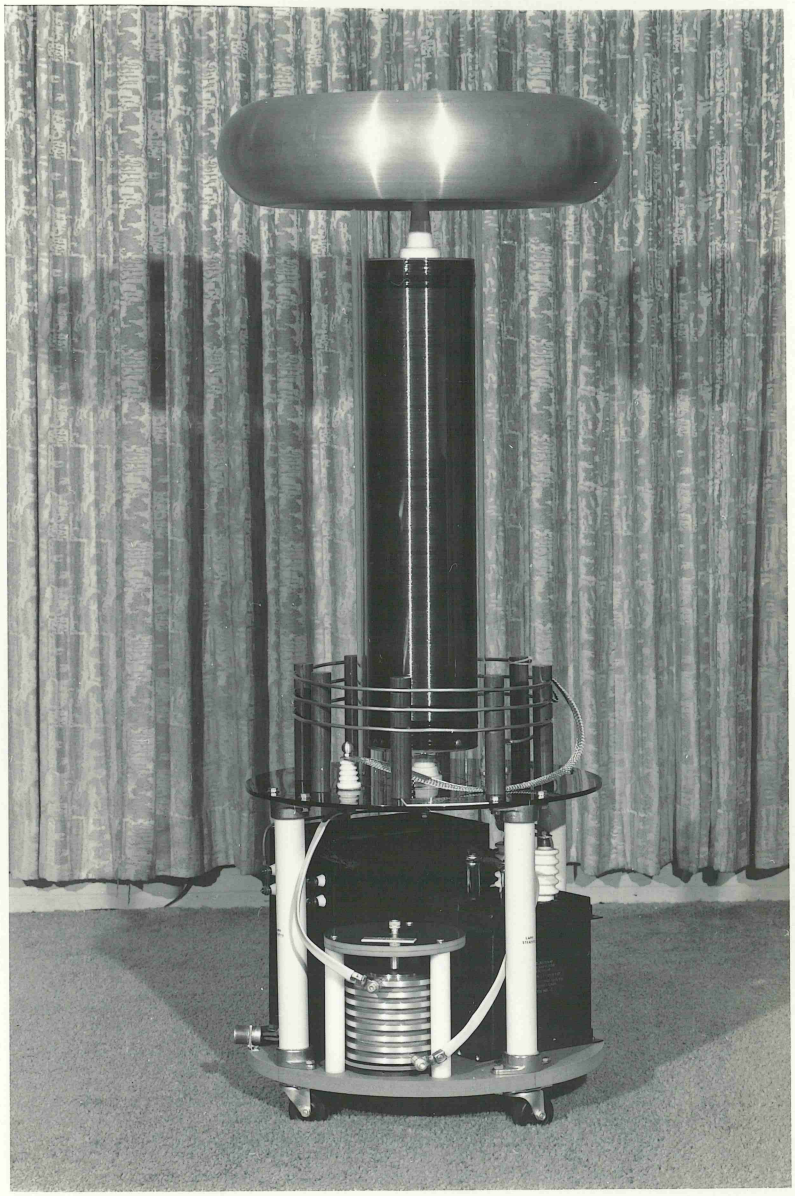
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



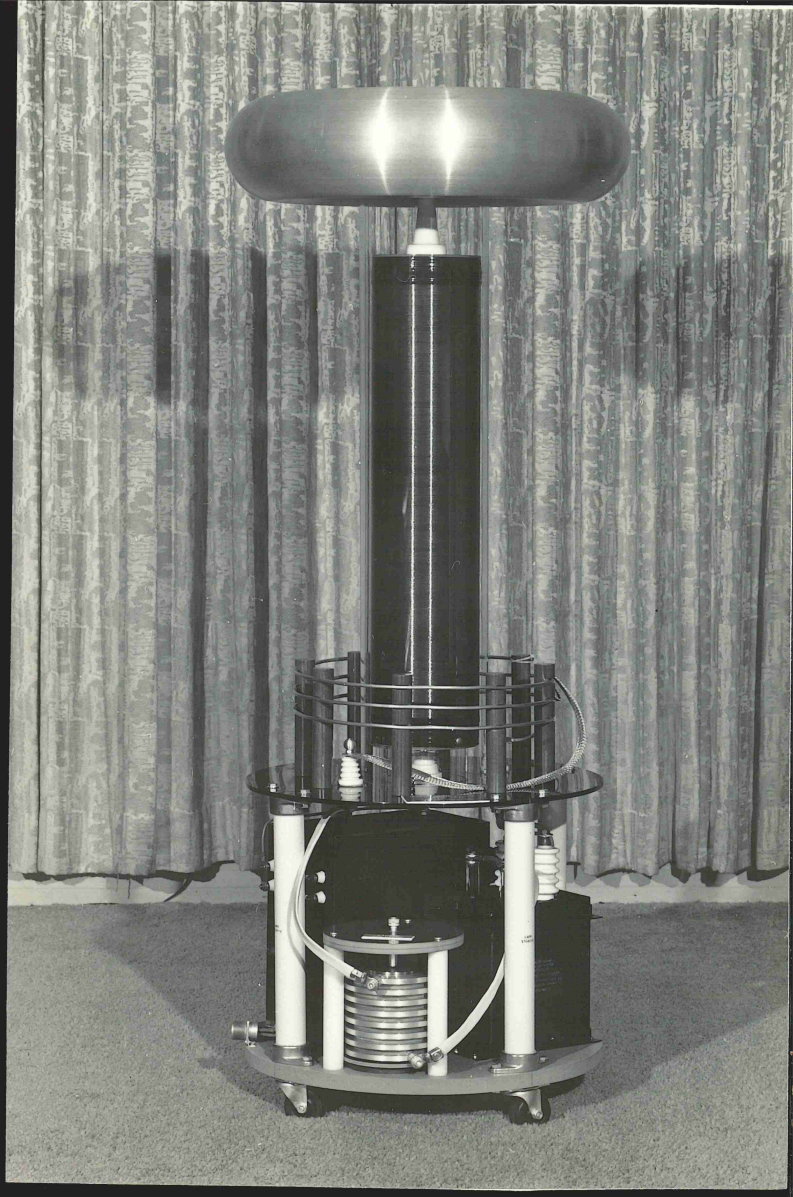
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



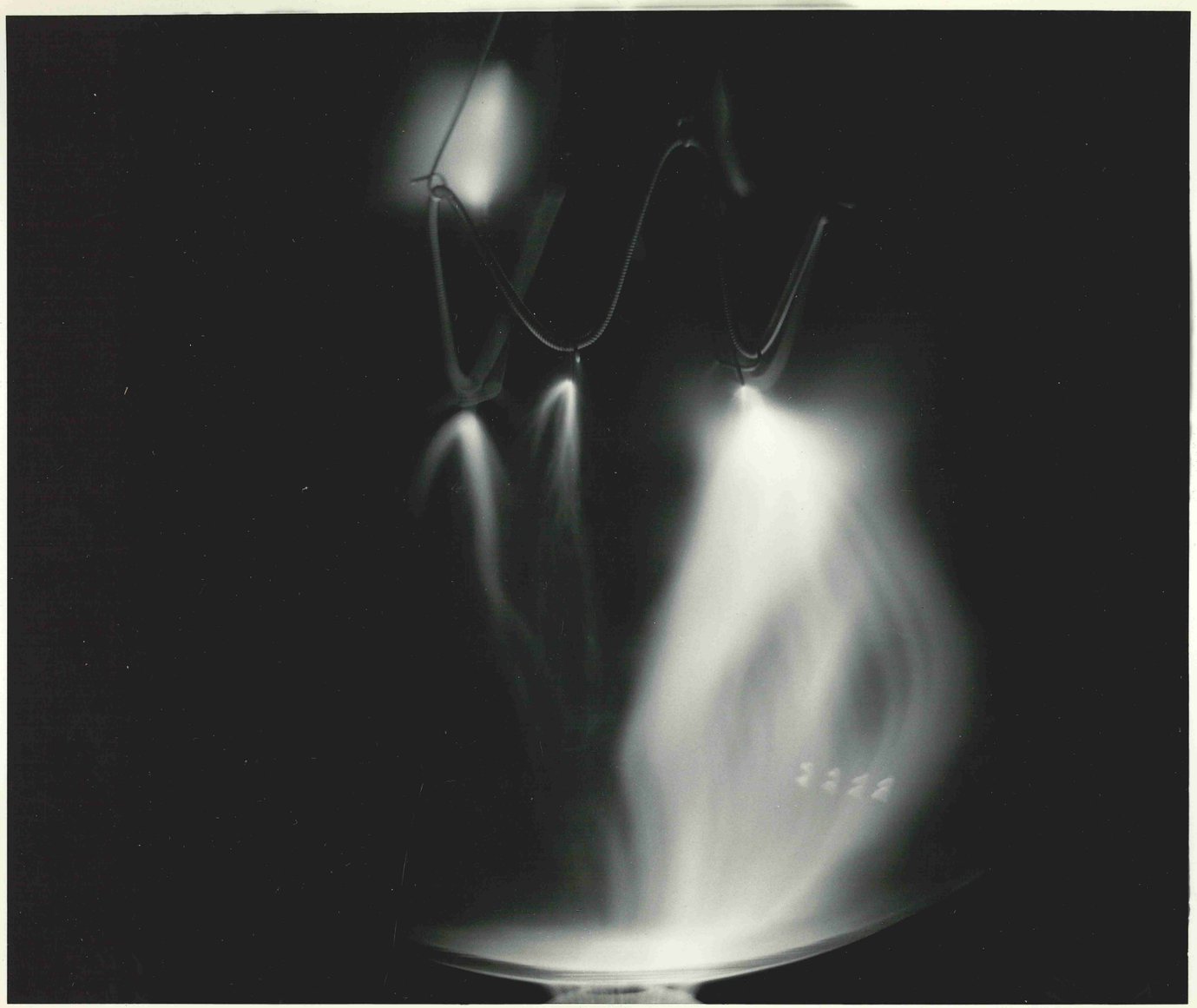
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

MODEL 5

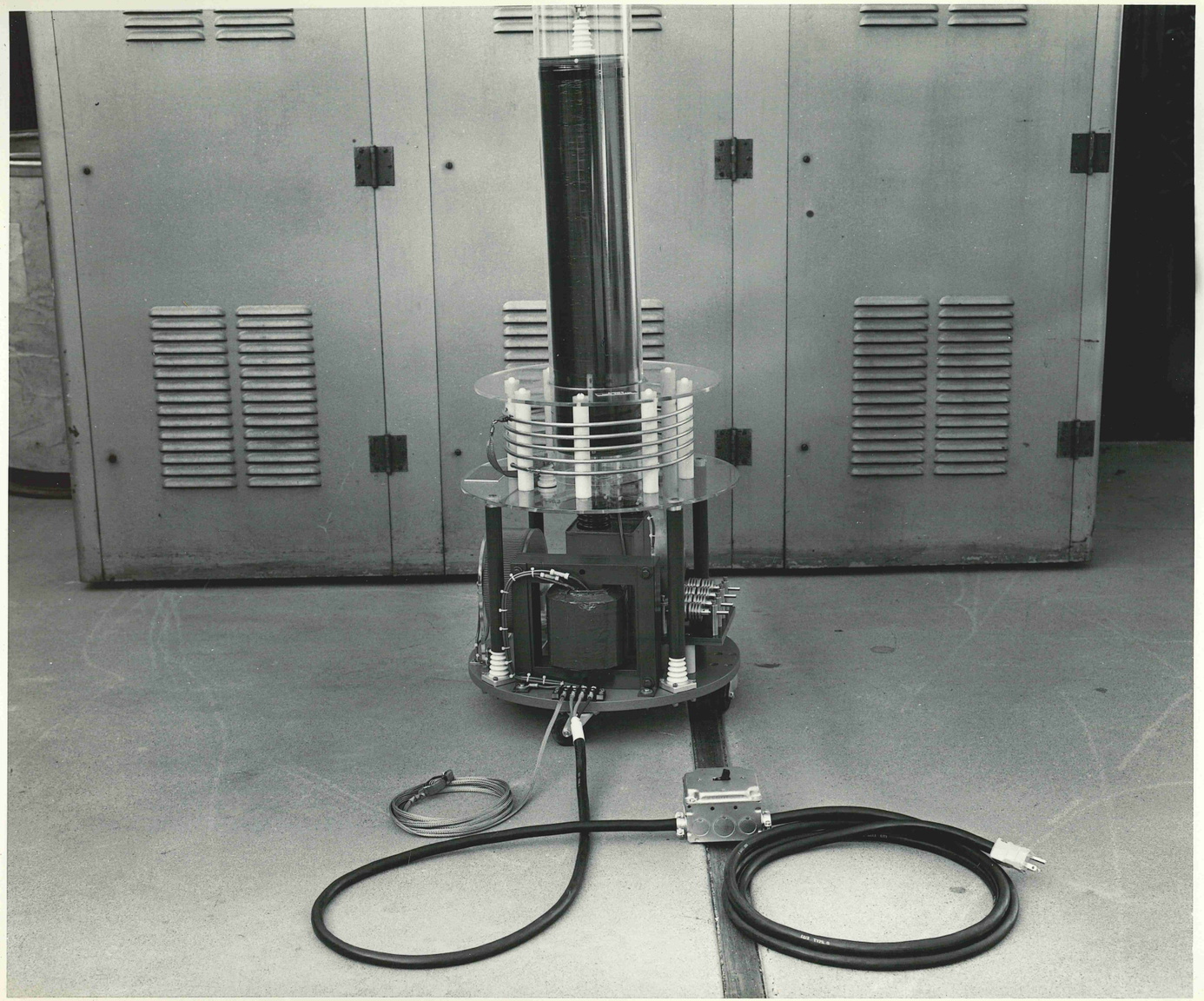
STARK COUNTY HISTORICAL SOCIETY

Bill W.

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



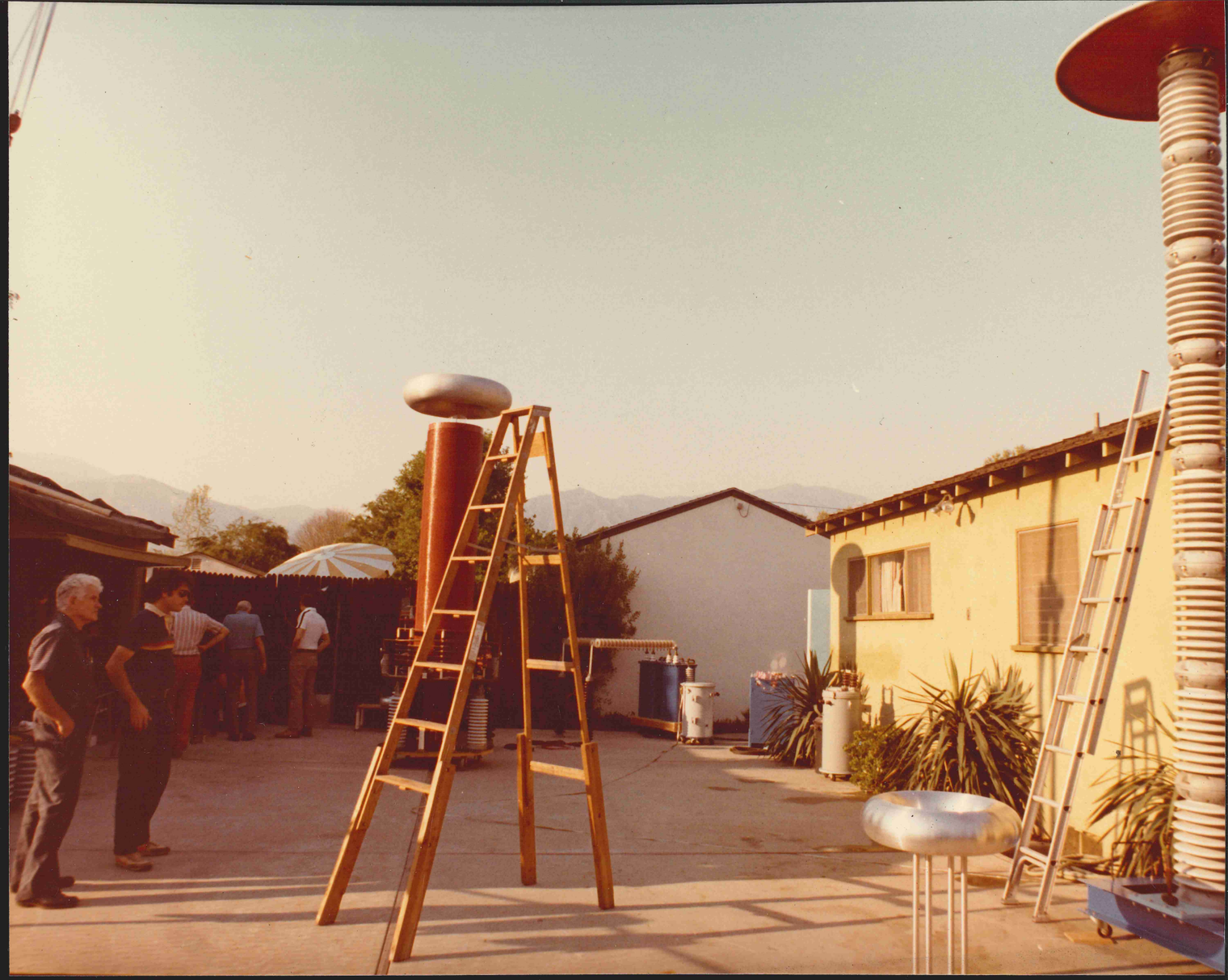
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

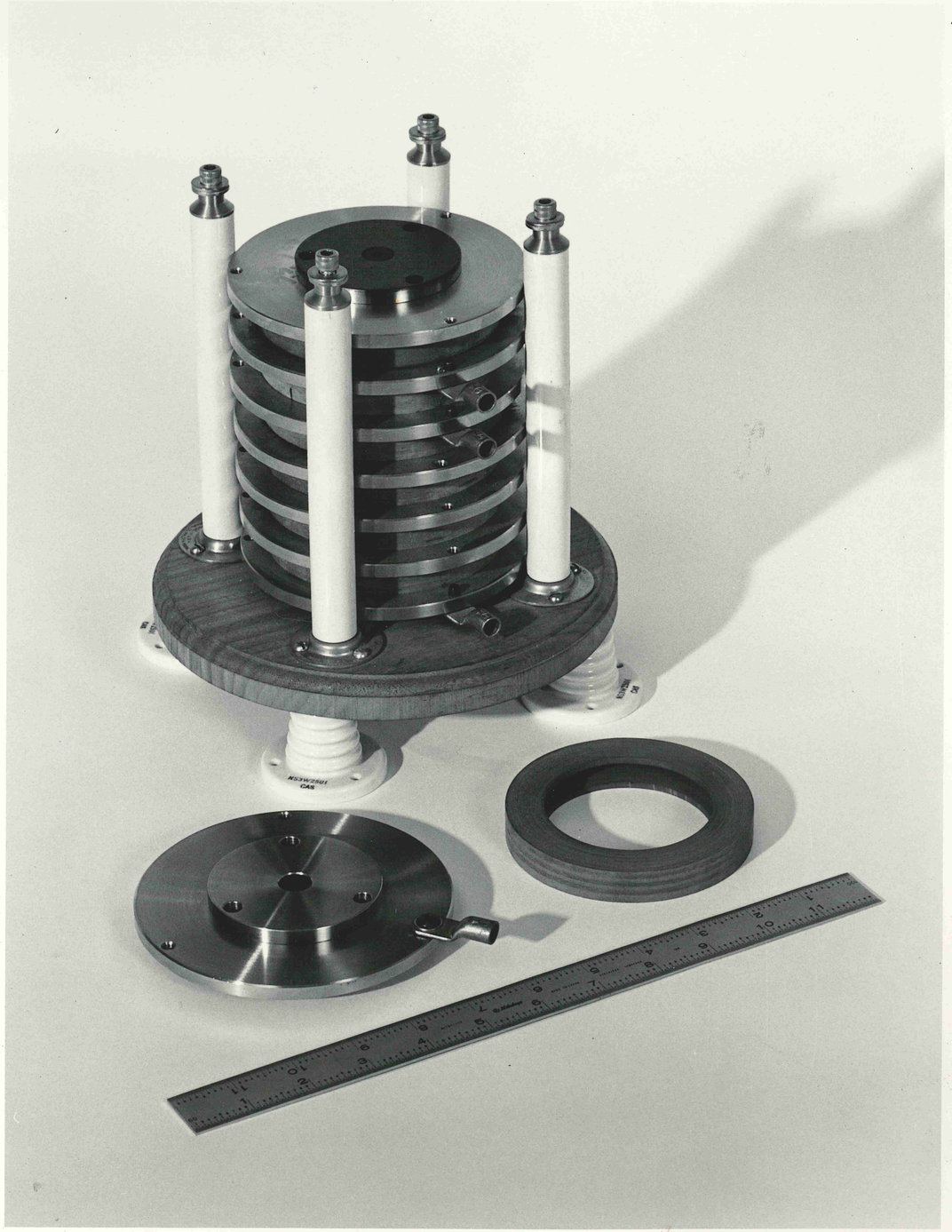


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



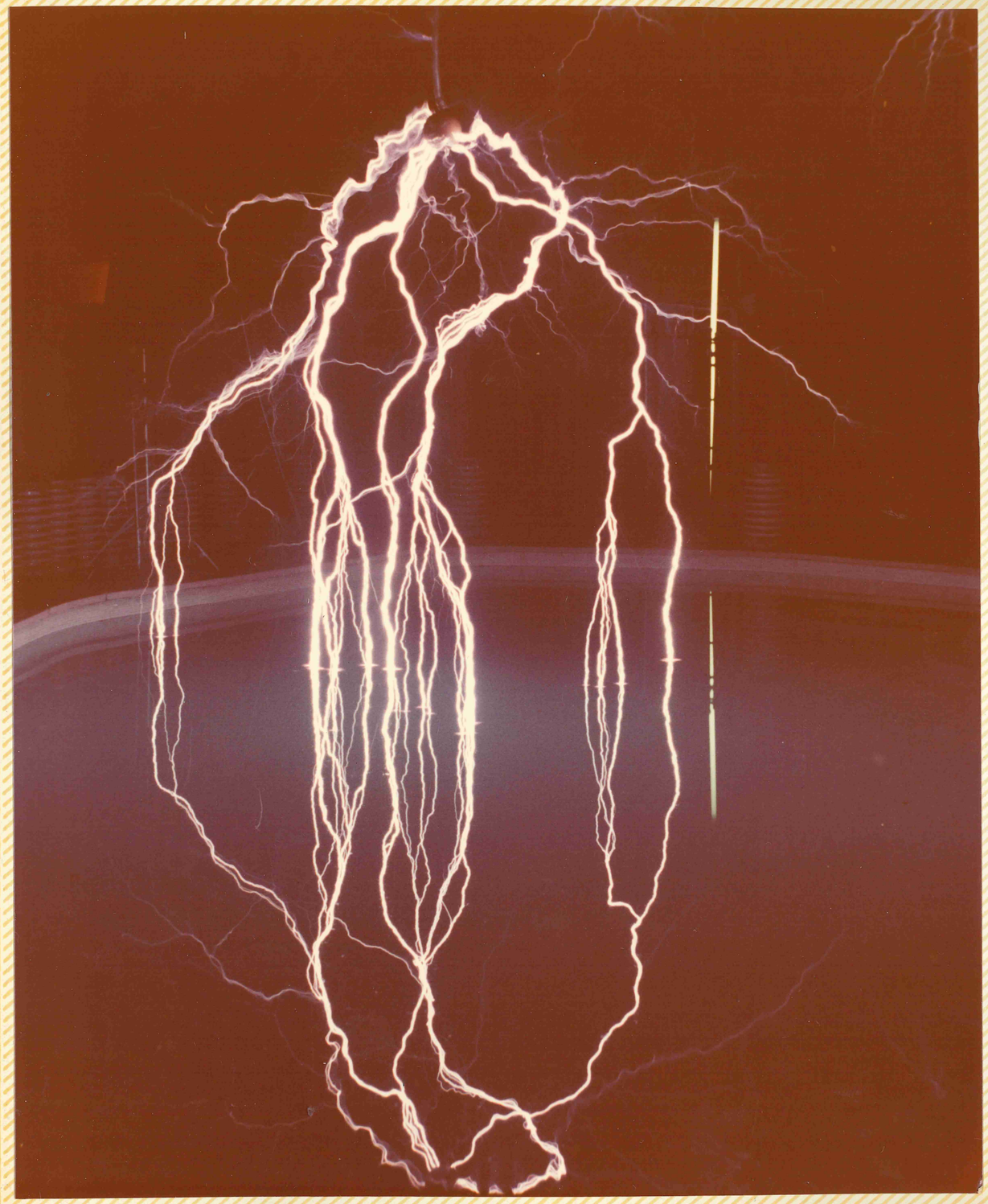
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP

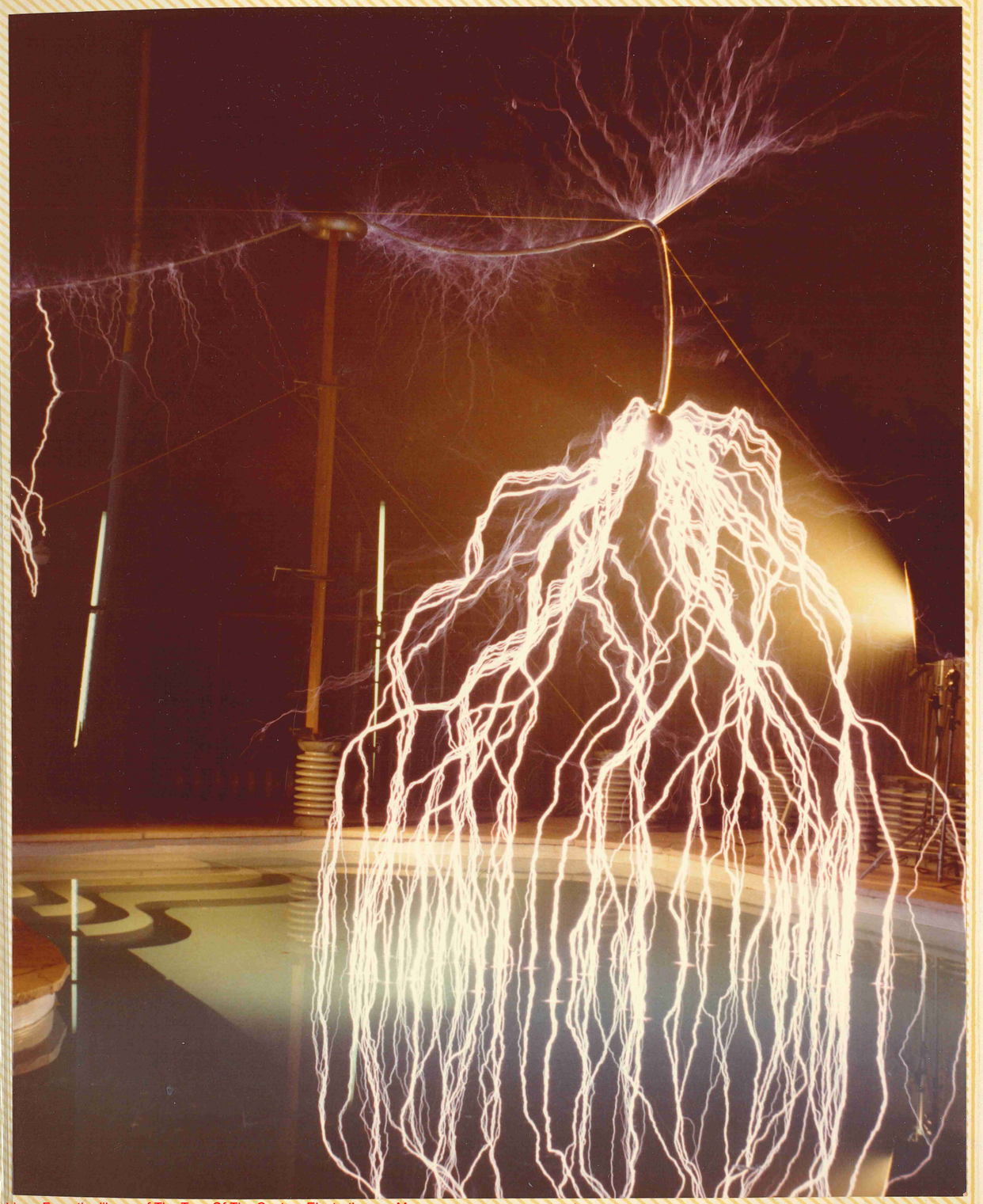


PROFESSIONAL SOUND SYSTEMS PHOTO C

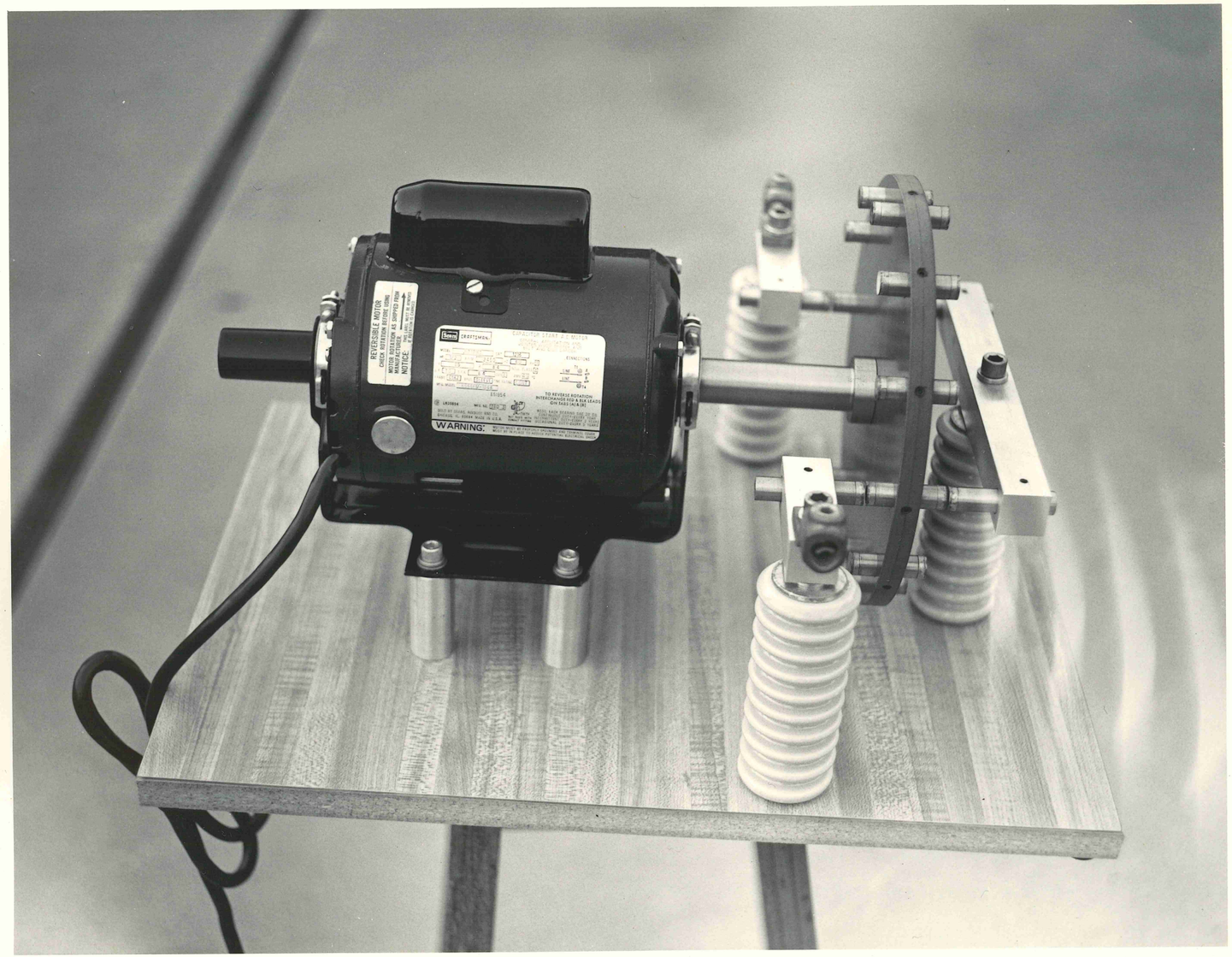
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



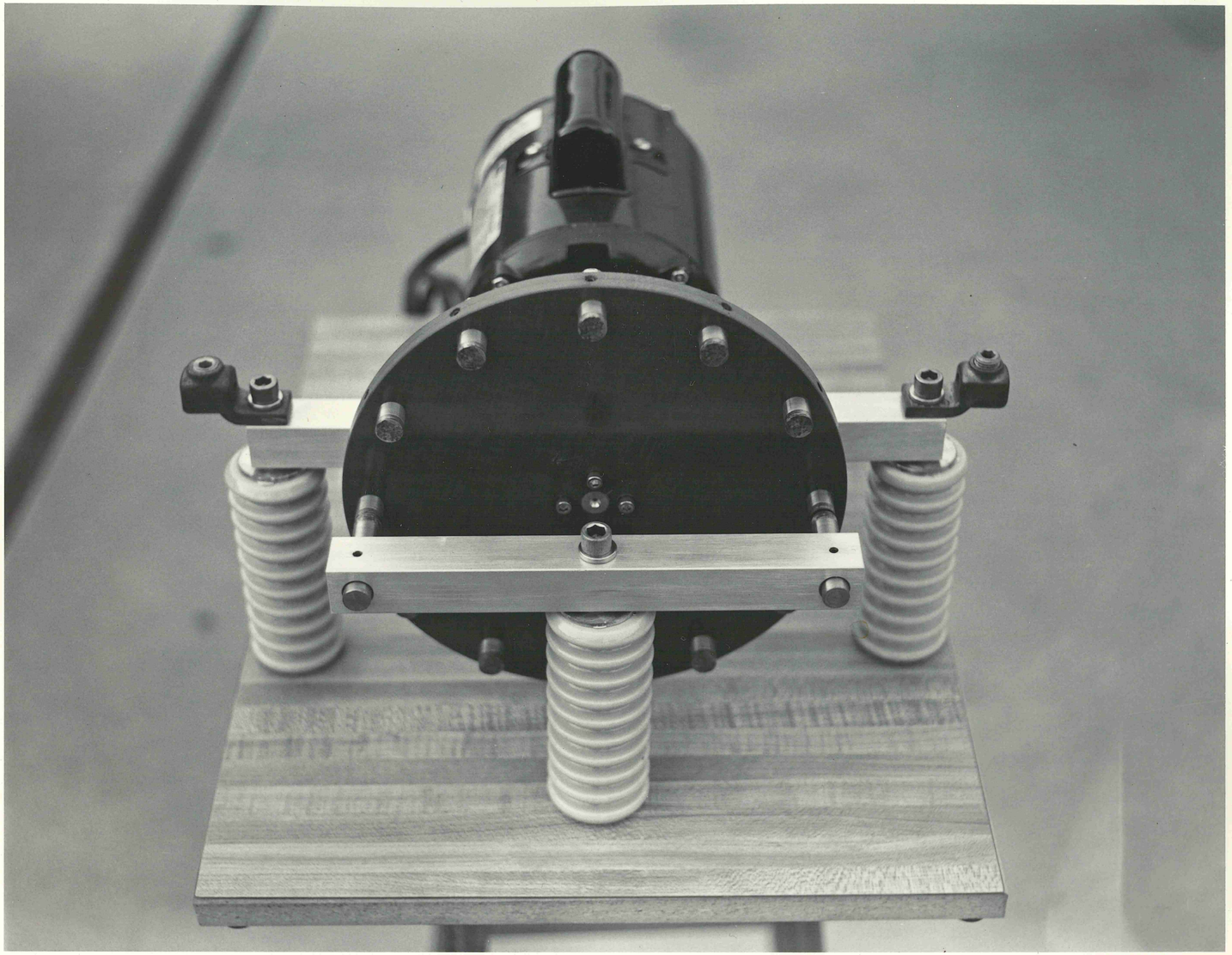
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



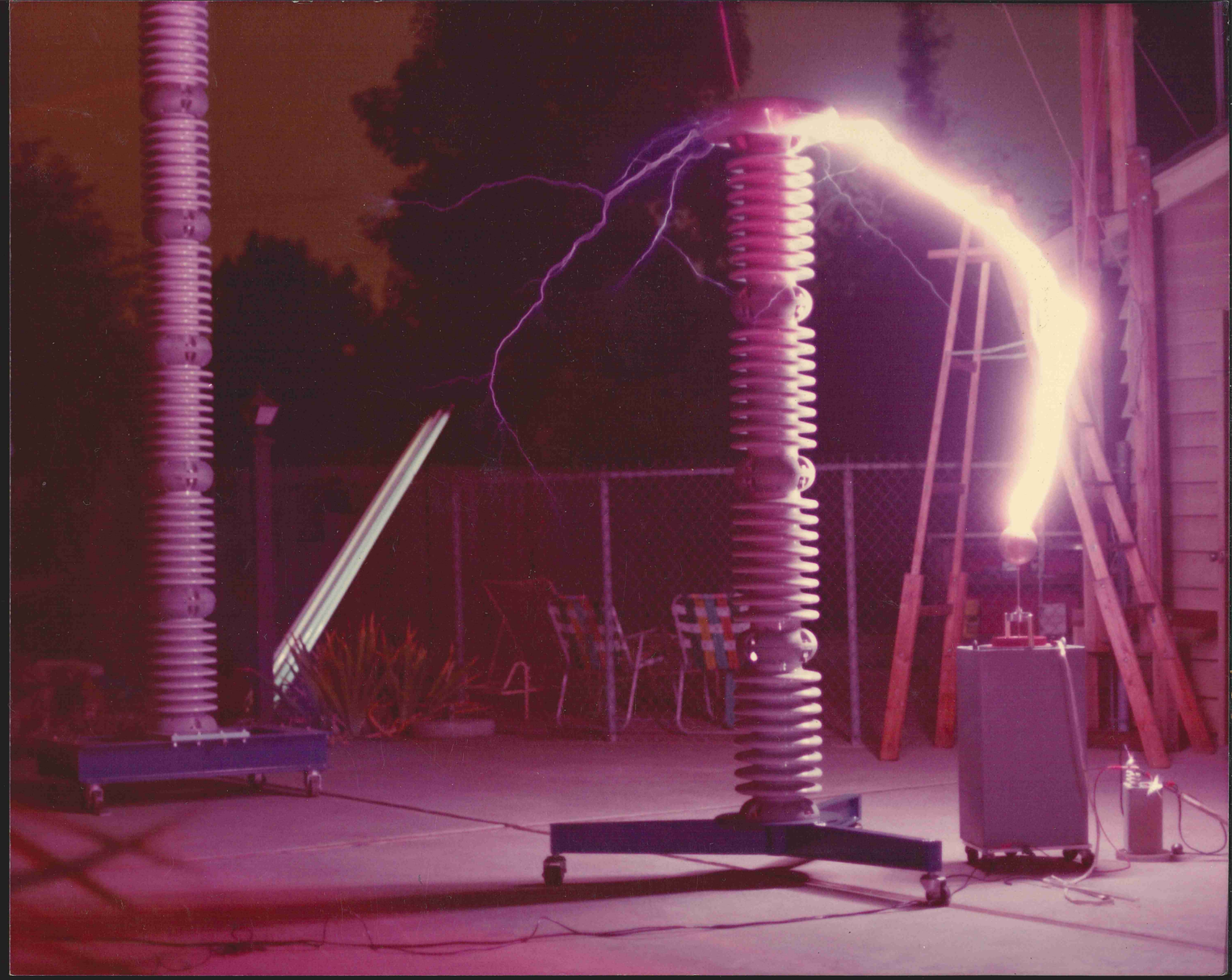
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP

(15) PROTOTYPE QUENCHED SPARK GAP: 2.5 KVA CAPACITY, CIRCA 1975

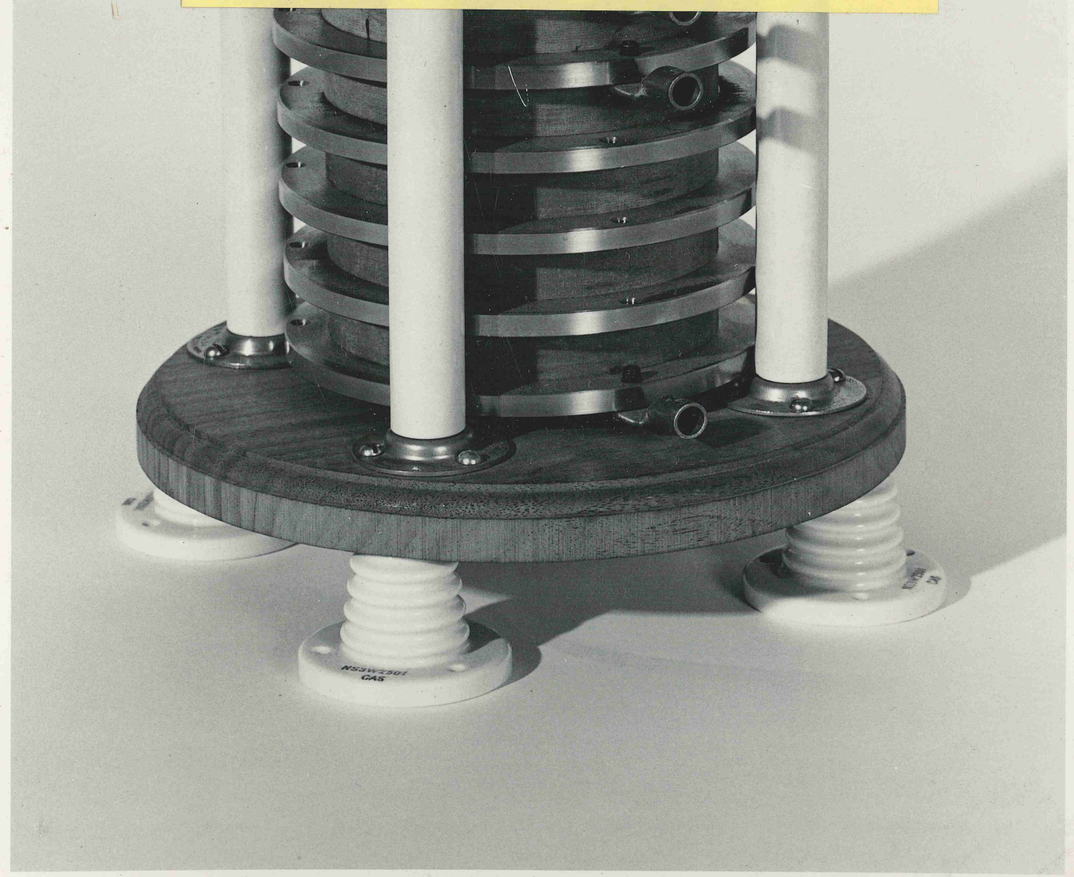


PHOTO D

PROFESSIONAL SOUND SYSTEMS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

THIS SIDE UP

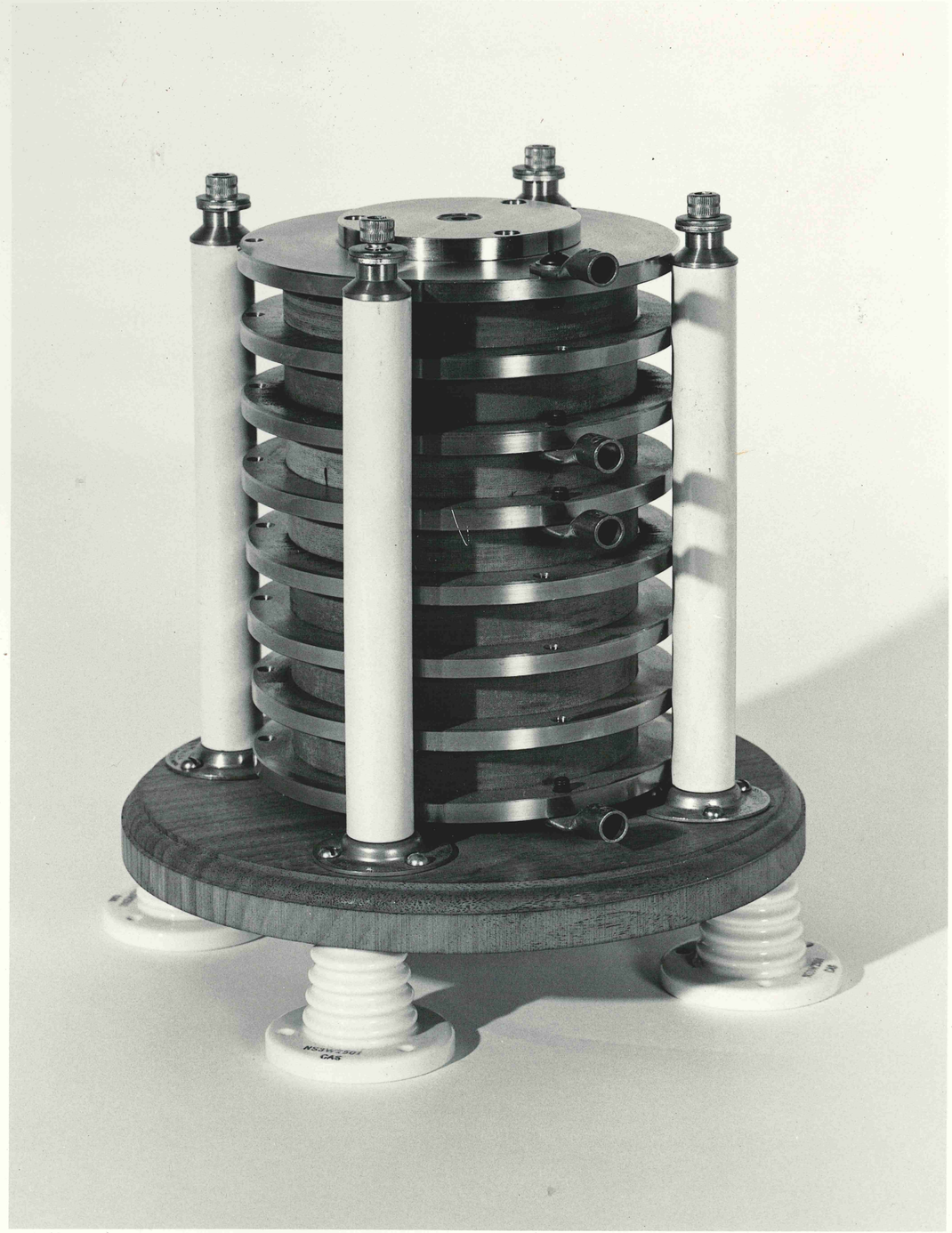
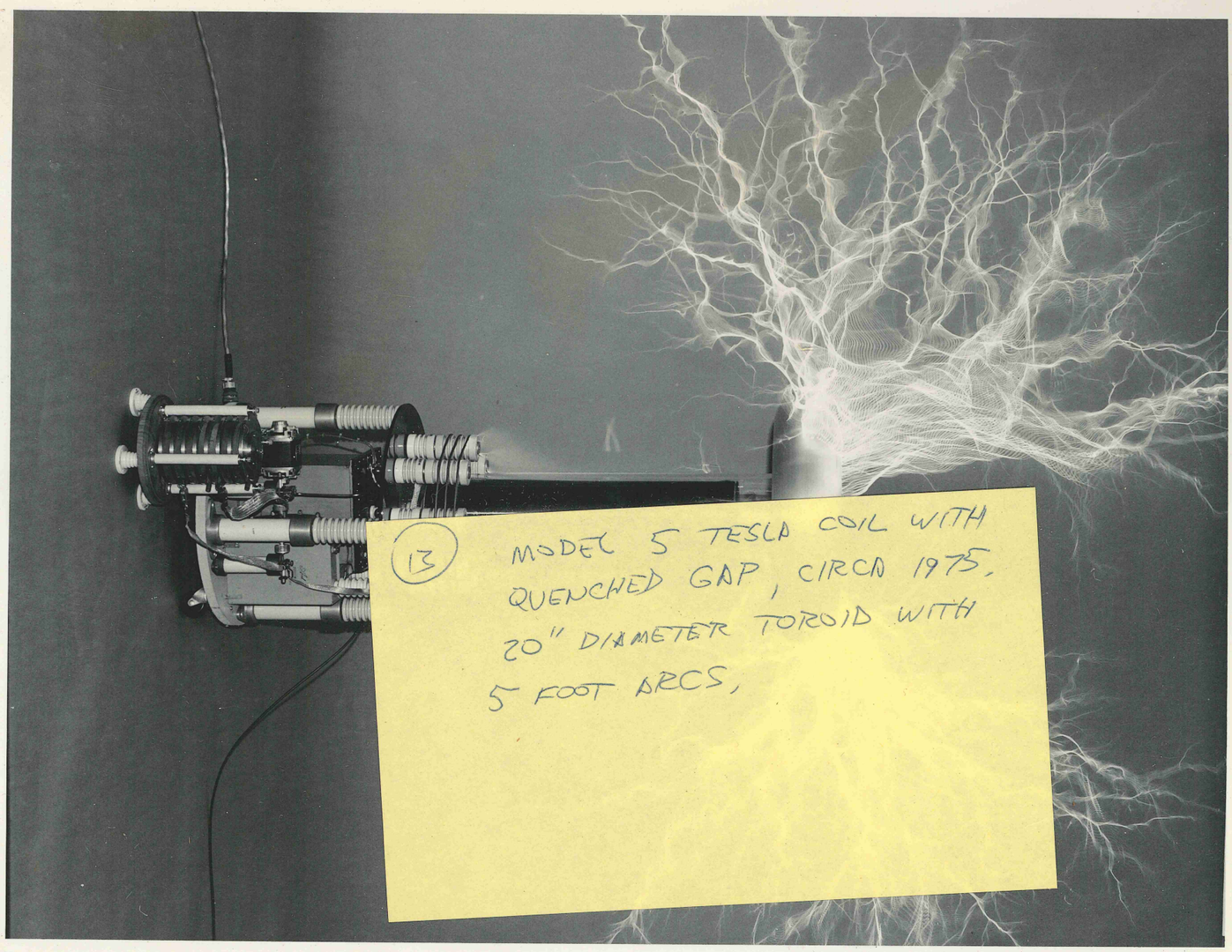


PHOTO D

PROFESSIONAL SOUND SYSTEMS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



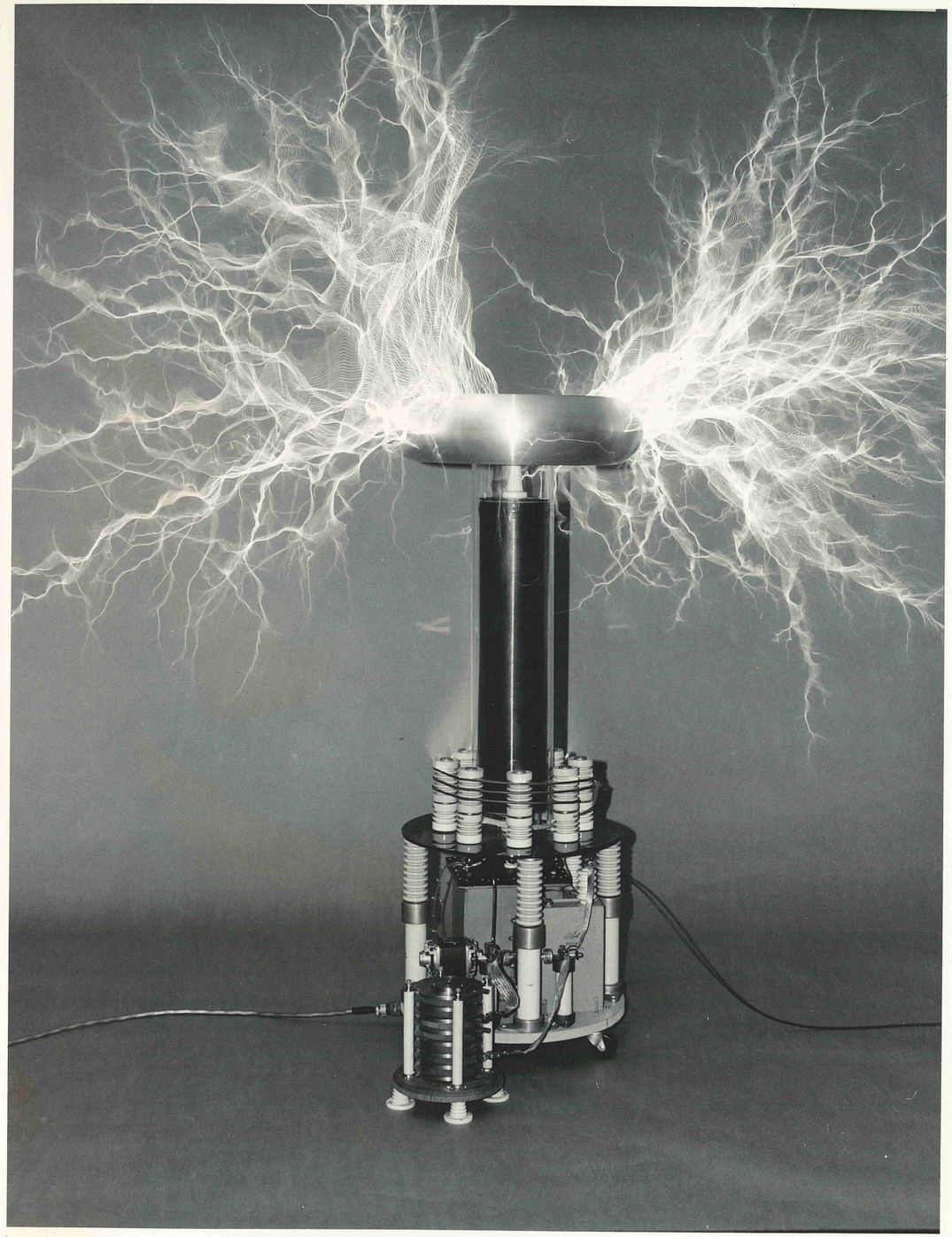
(13) MODEL 5 TESLA COIL WITH QUENCHED GAP, CIRCA 1975. 20" DIAMETER TOROID WITH 5' FOOT ARCS.

THIS SIDE UP

PROFESSIONAL SOUND SYSTEMS

FRONT COVER PHOTO A

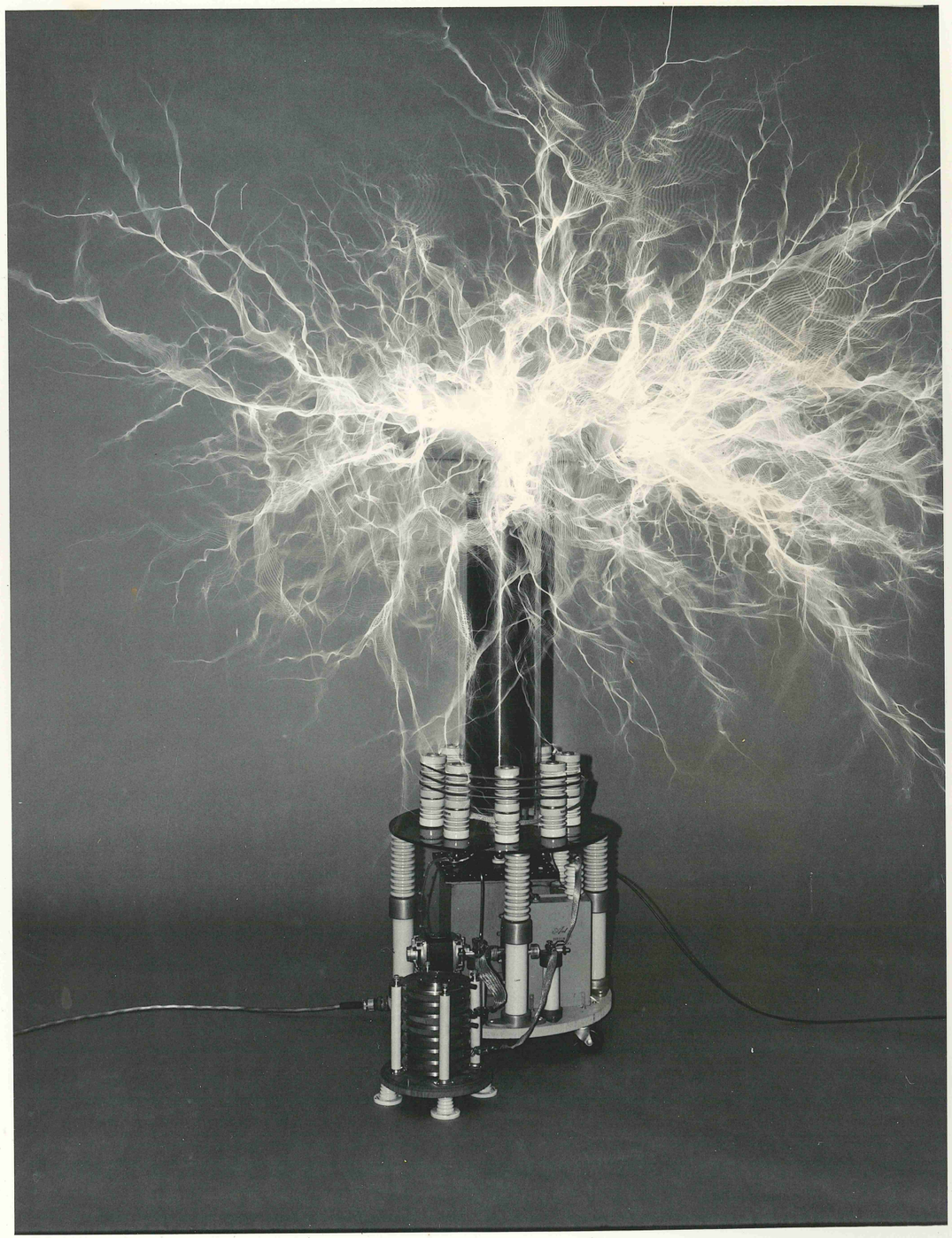
THIS SIDE UP



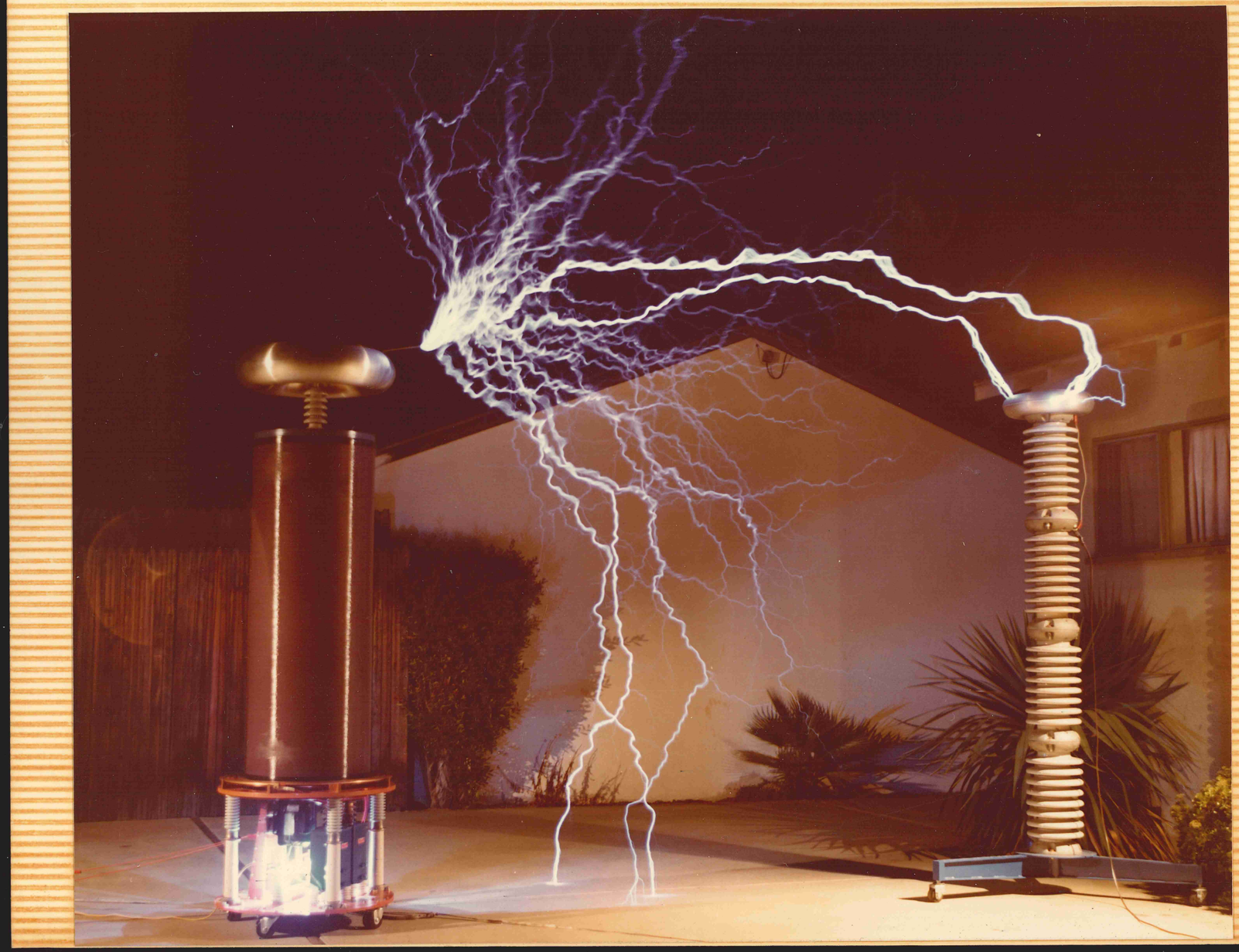
FRONT COVER PHOTO A

PROFESSIONAL SOUND SYSTEMS

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



(14) MODEL 5 TESLA COIL SYSTEM WITH RACK MOUNTED POWER SUPPLY CIRCA 1976,

PHOTO 3

112% 85⅛

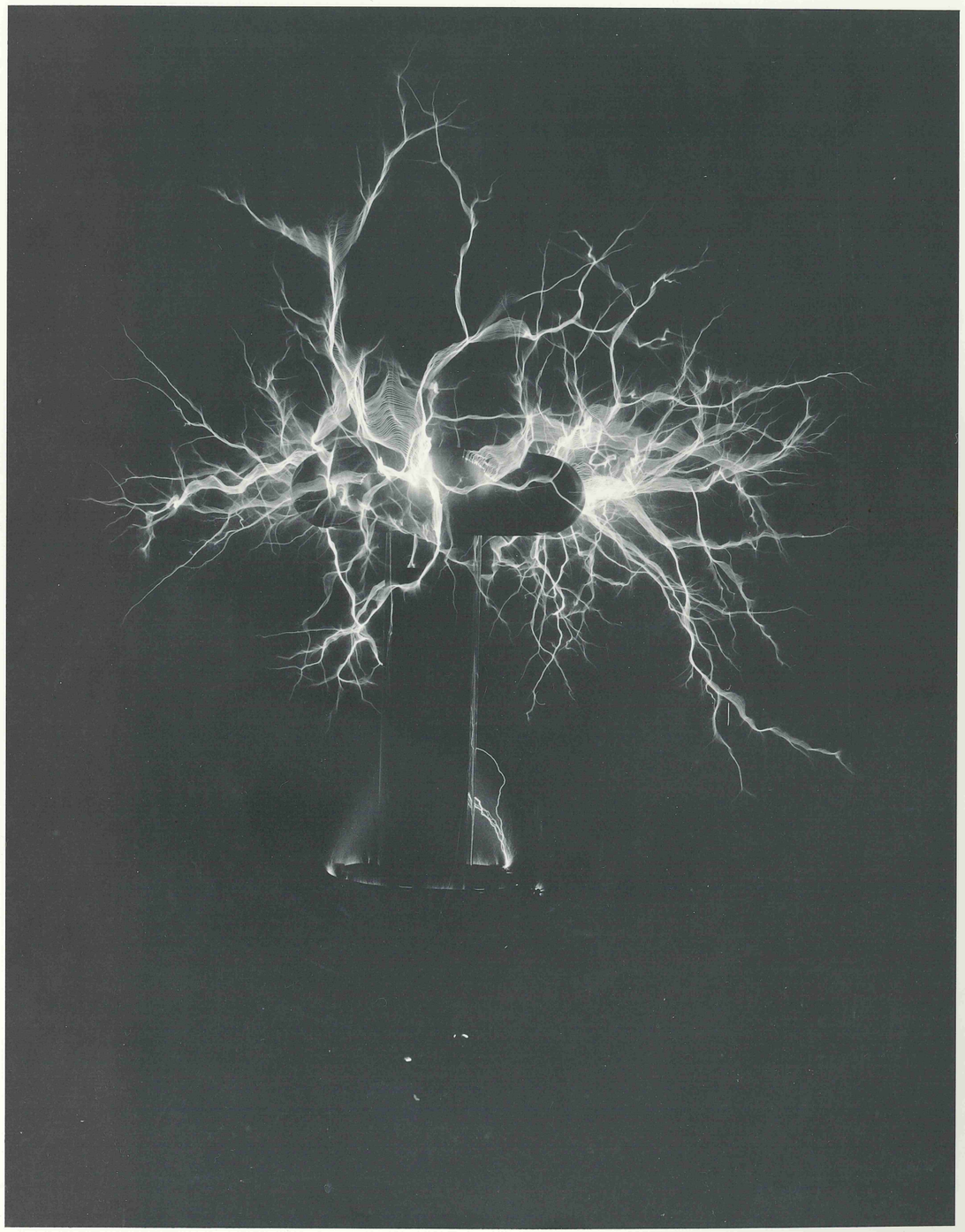
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



PHOTO 3

112% 85⅛

William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

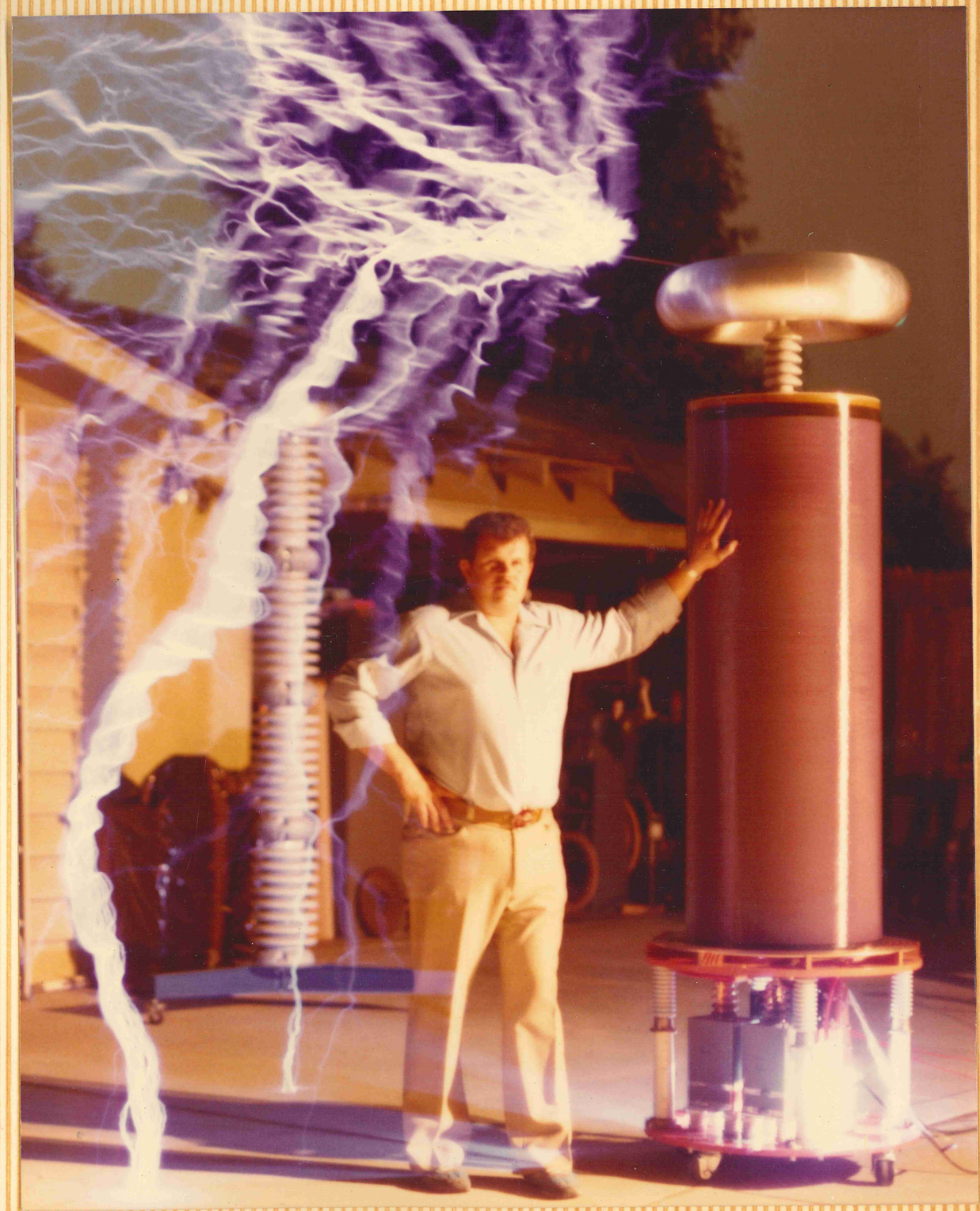




William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



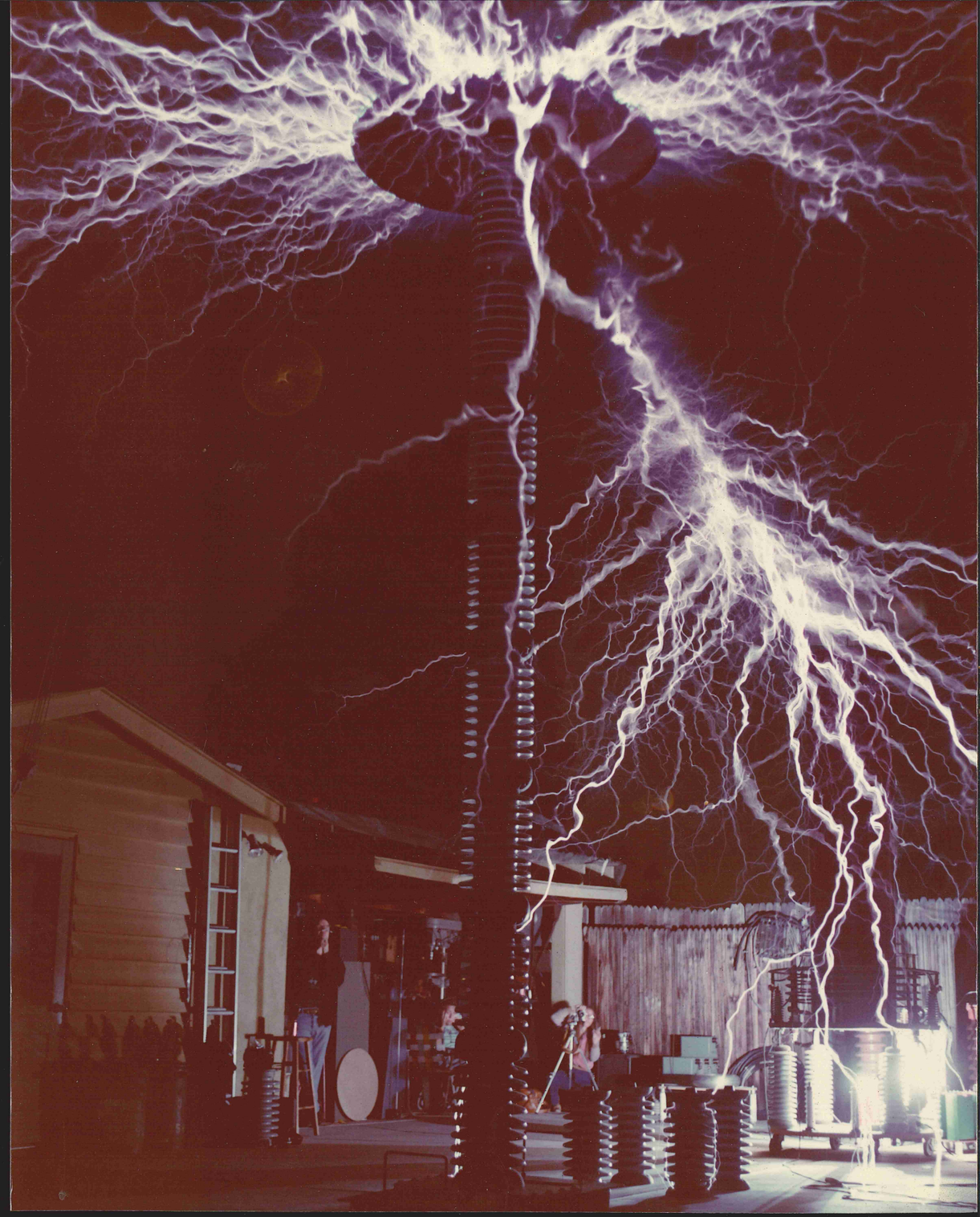
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

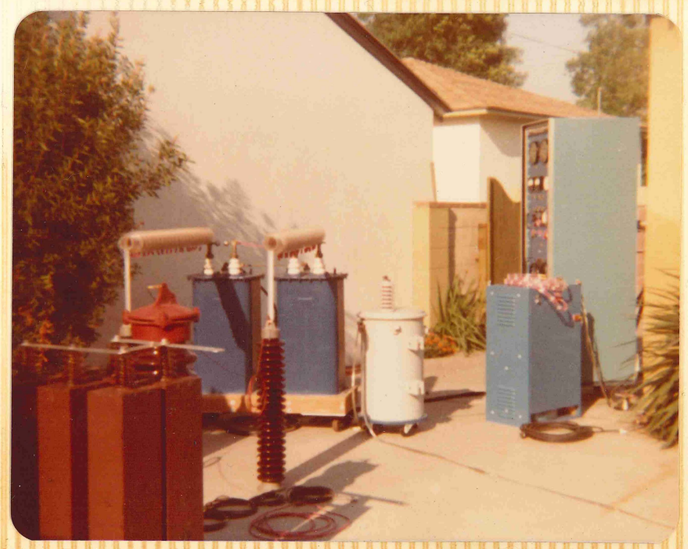


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

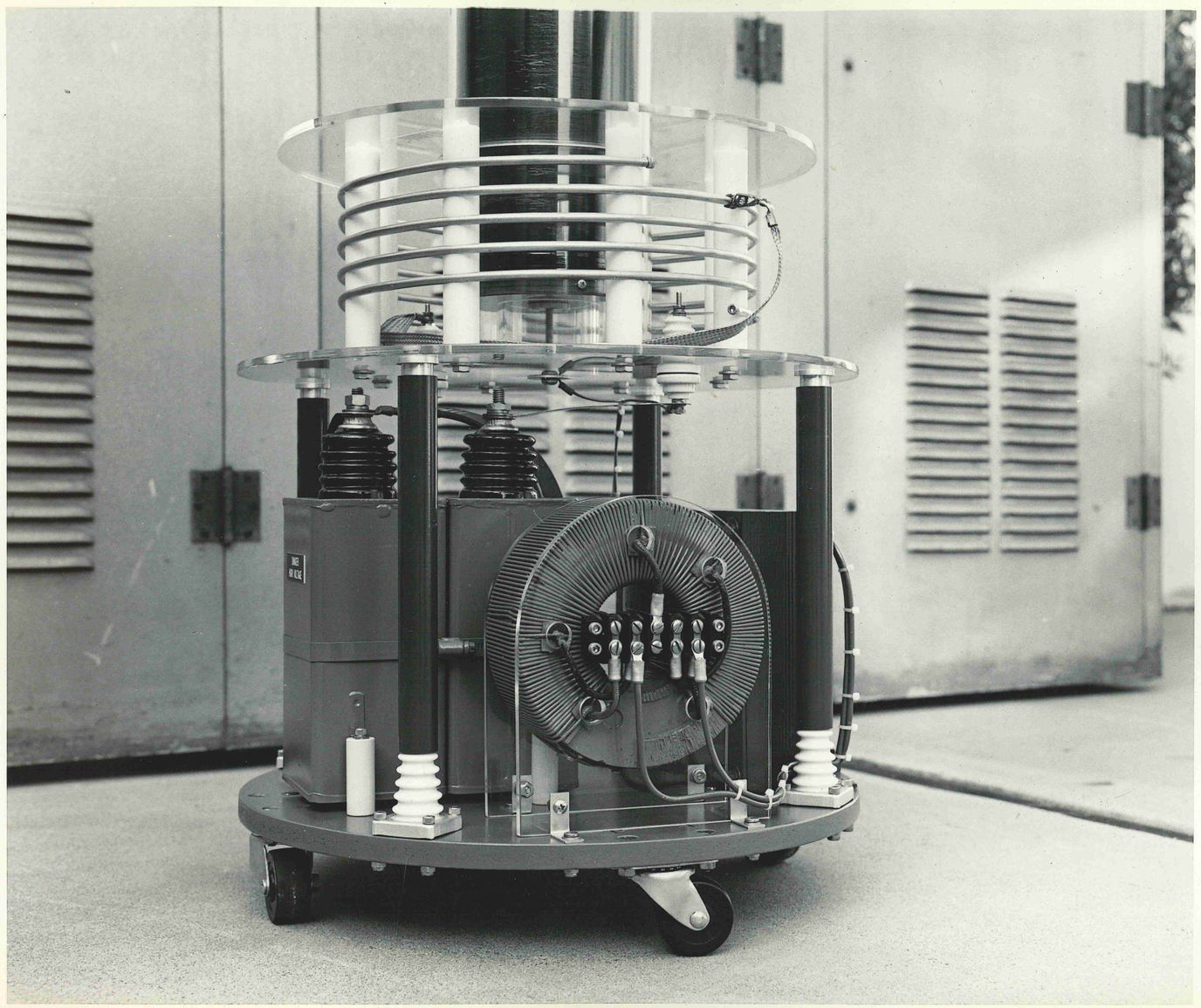


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

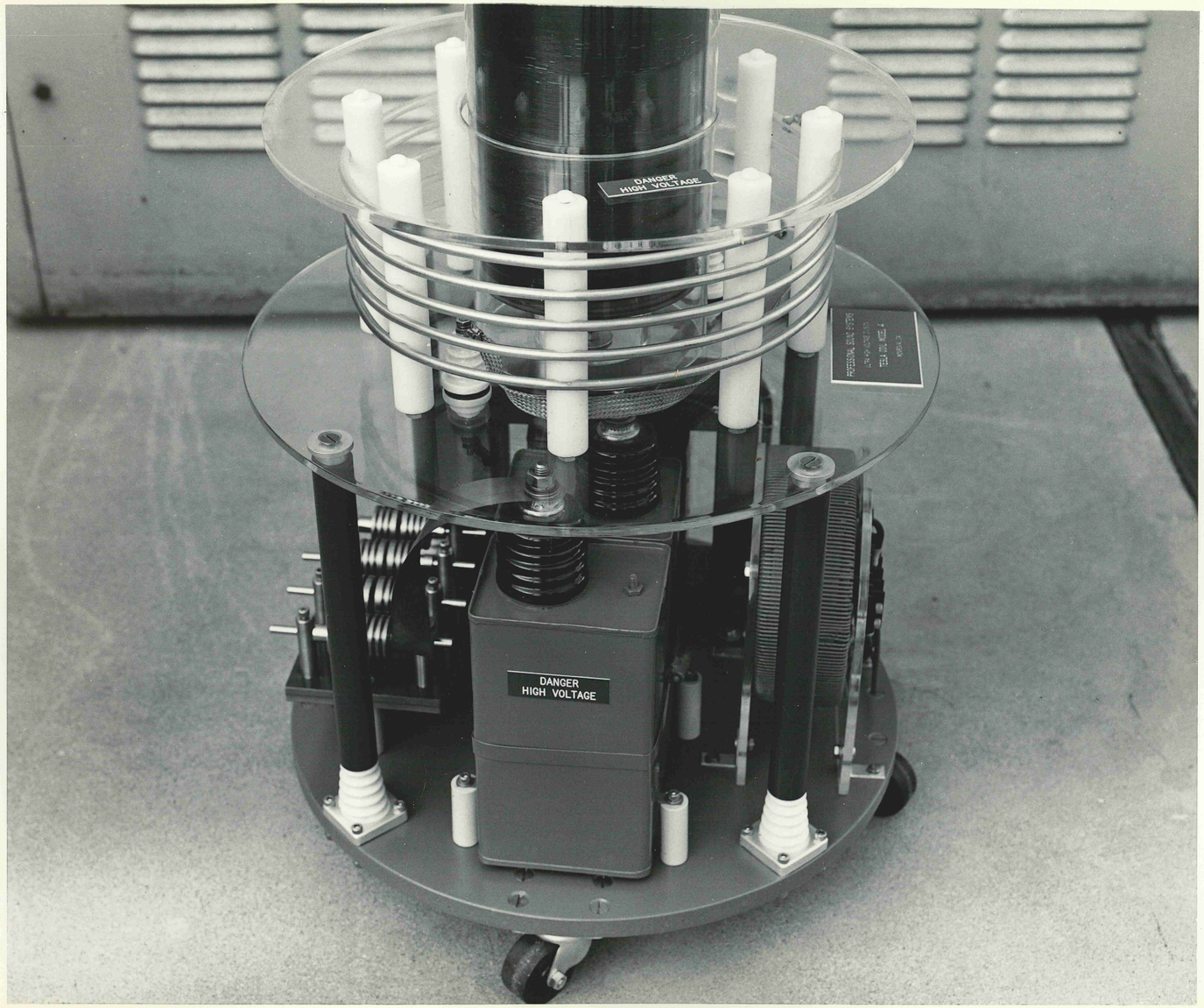




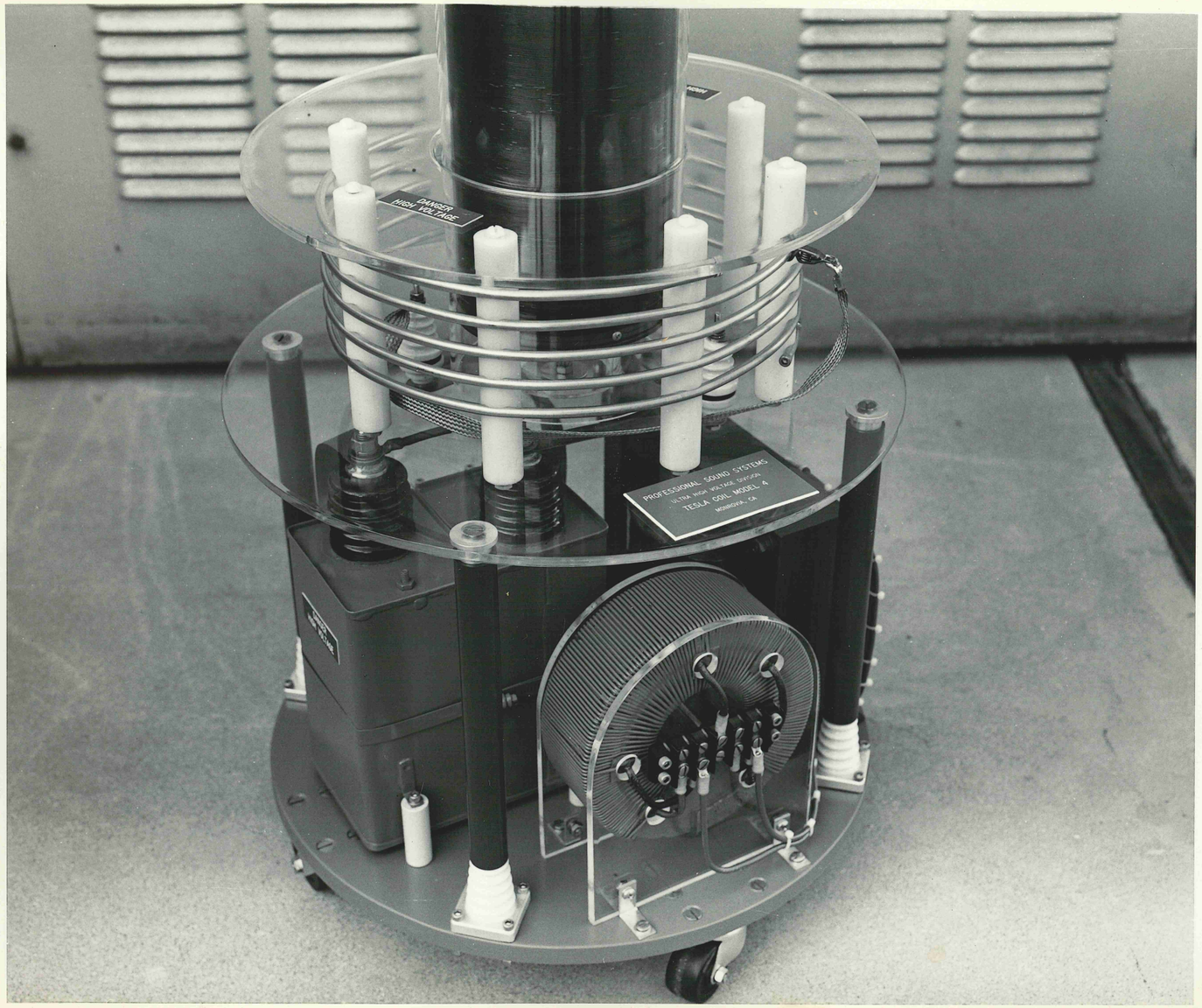
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



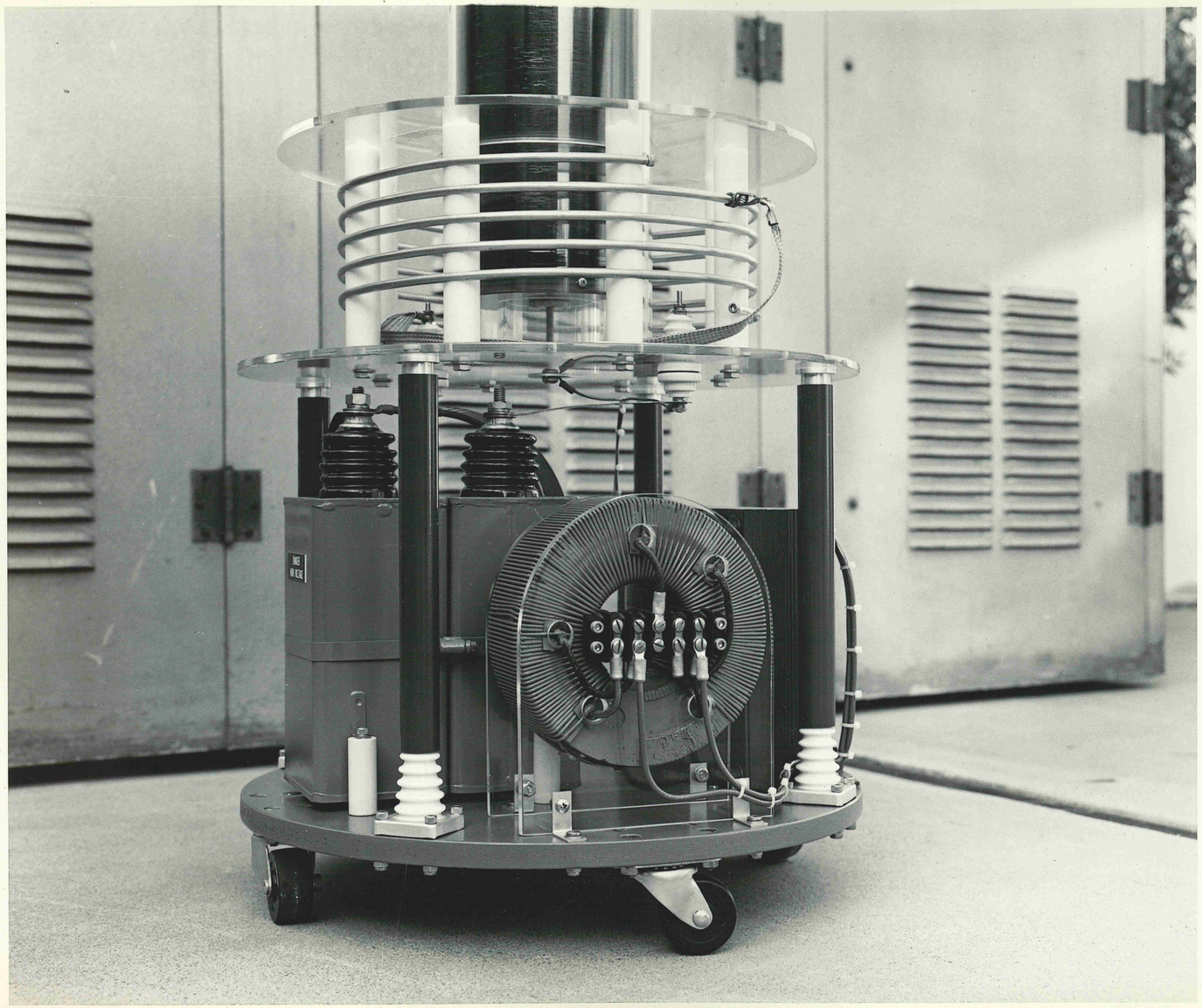
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



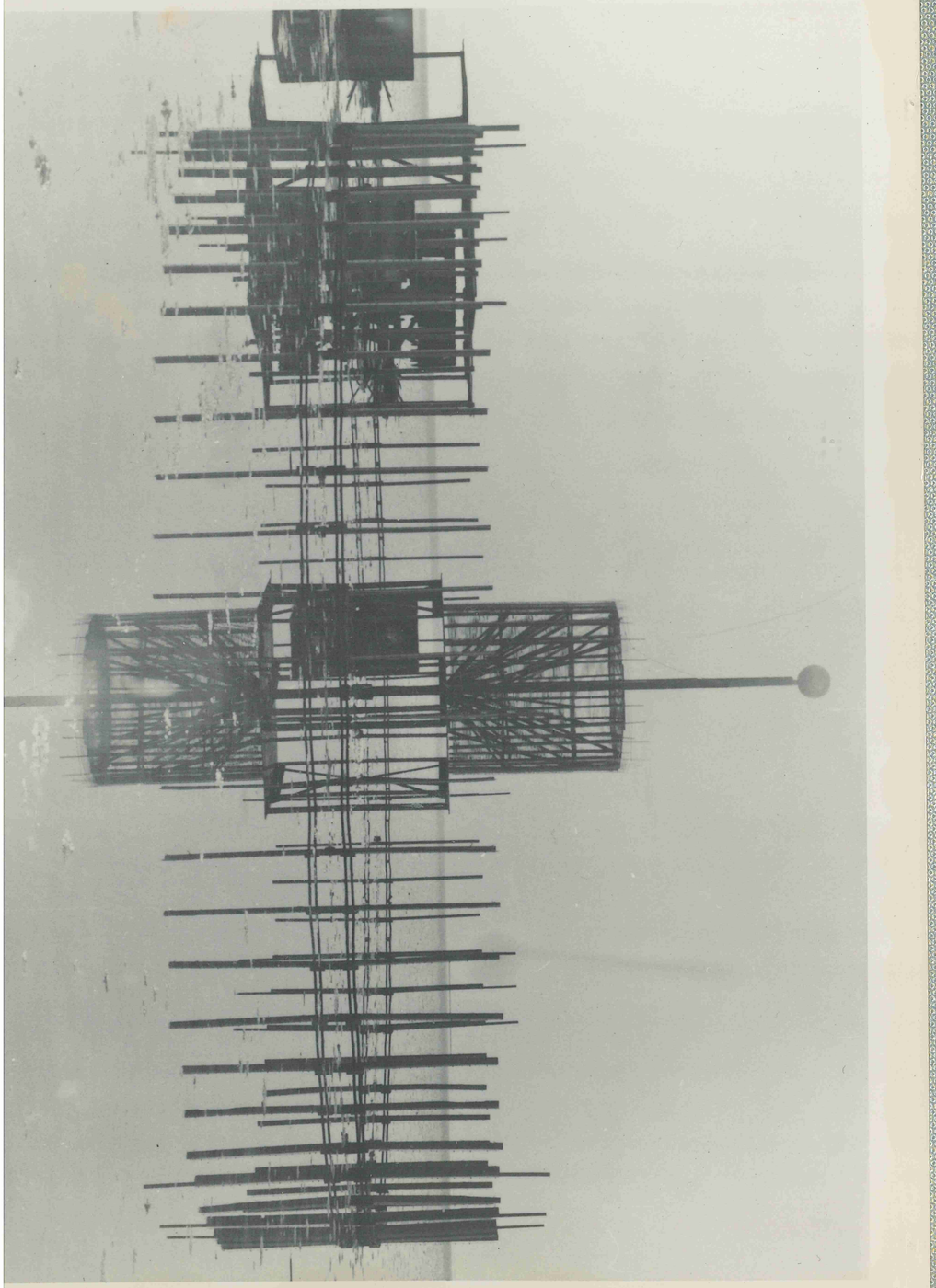
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

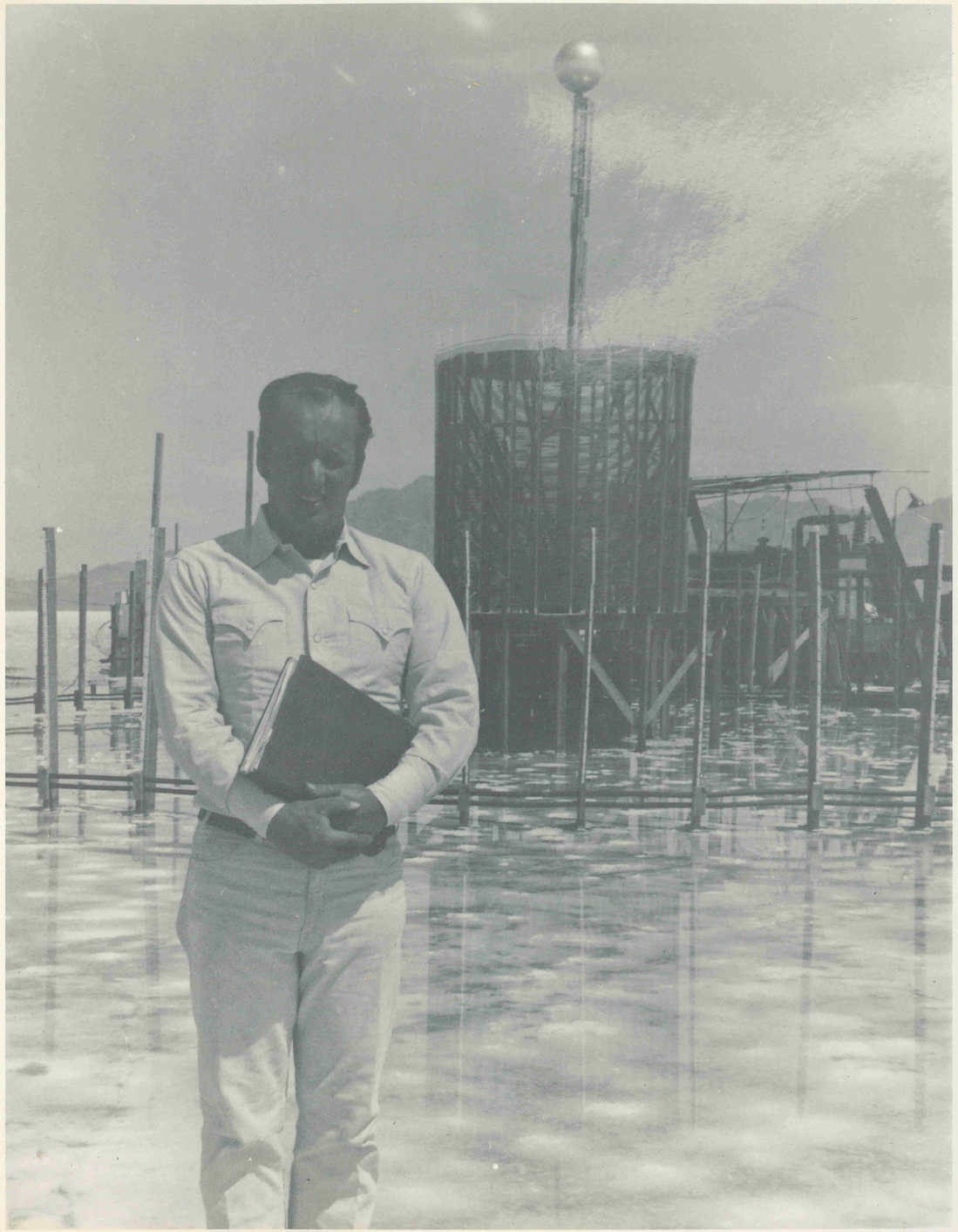


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

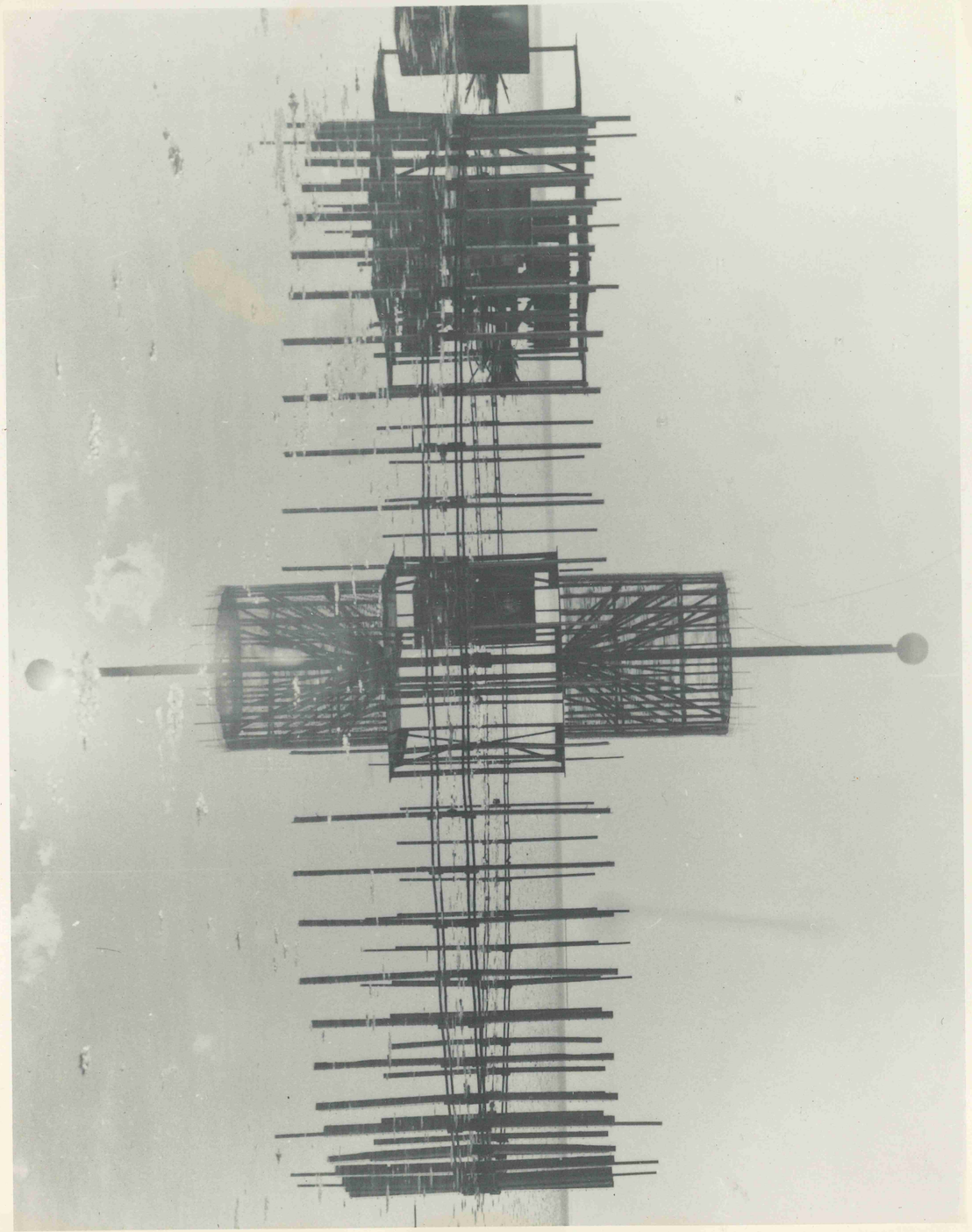


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



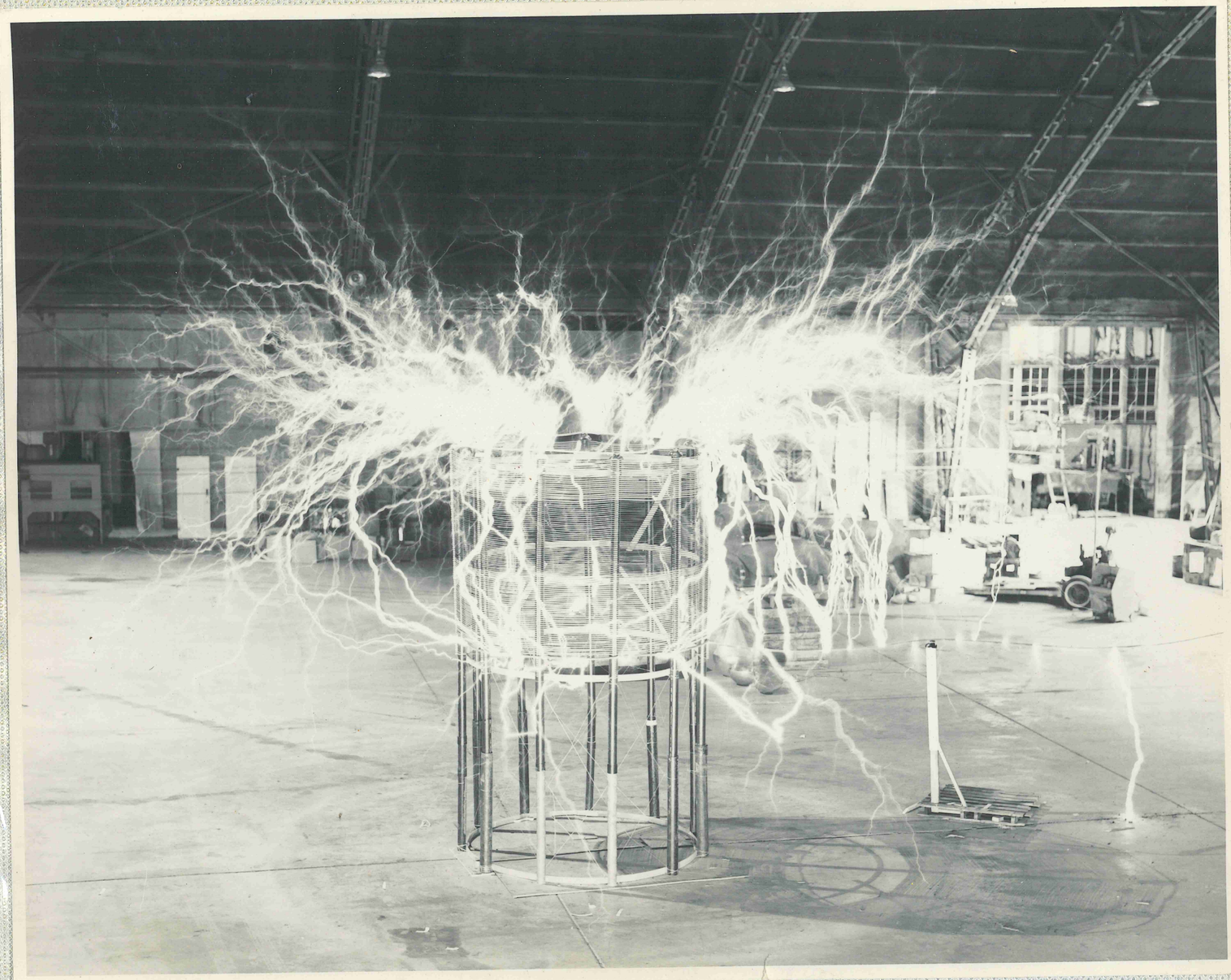


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

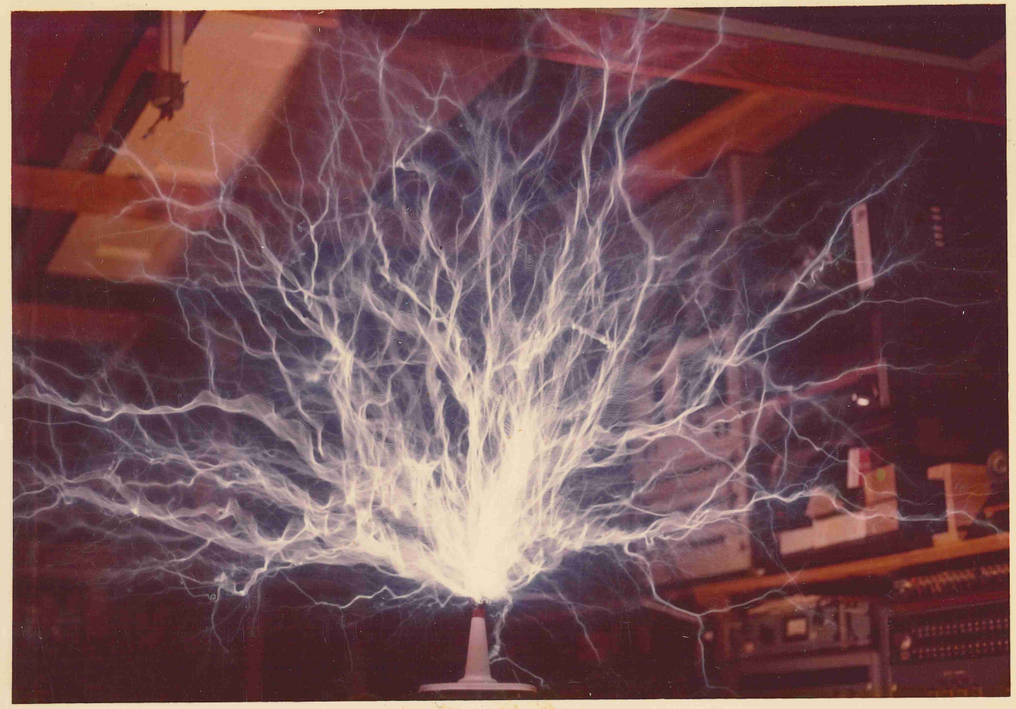


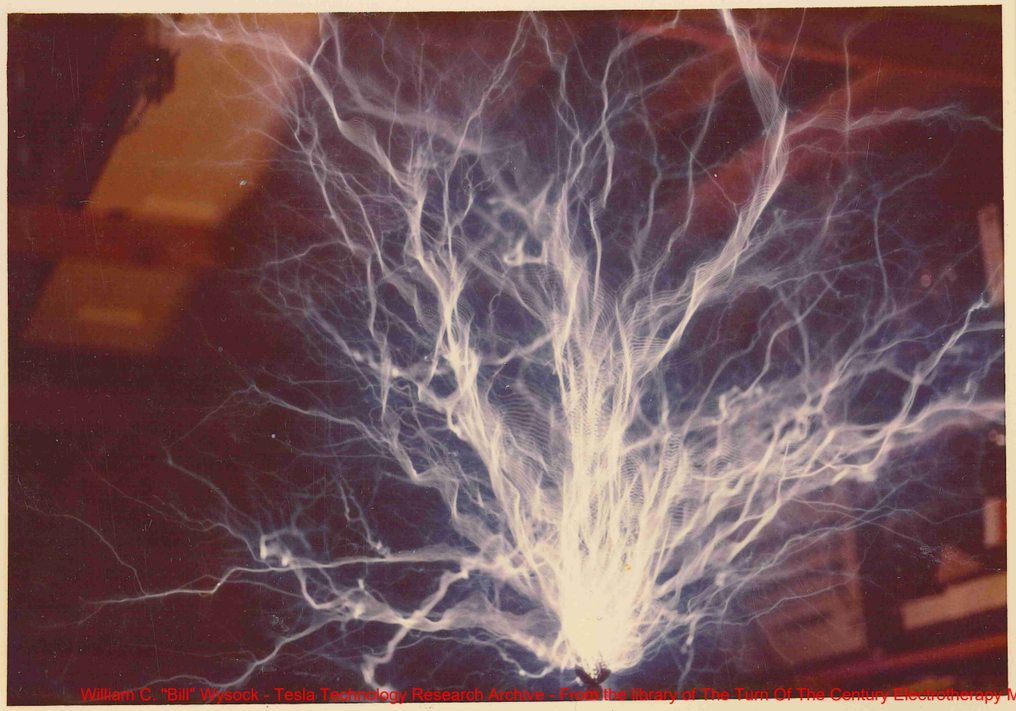


William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum

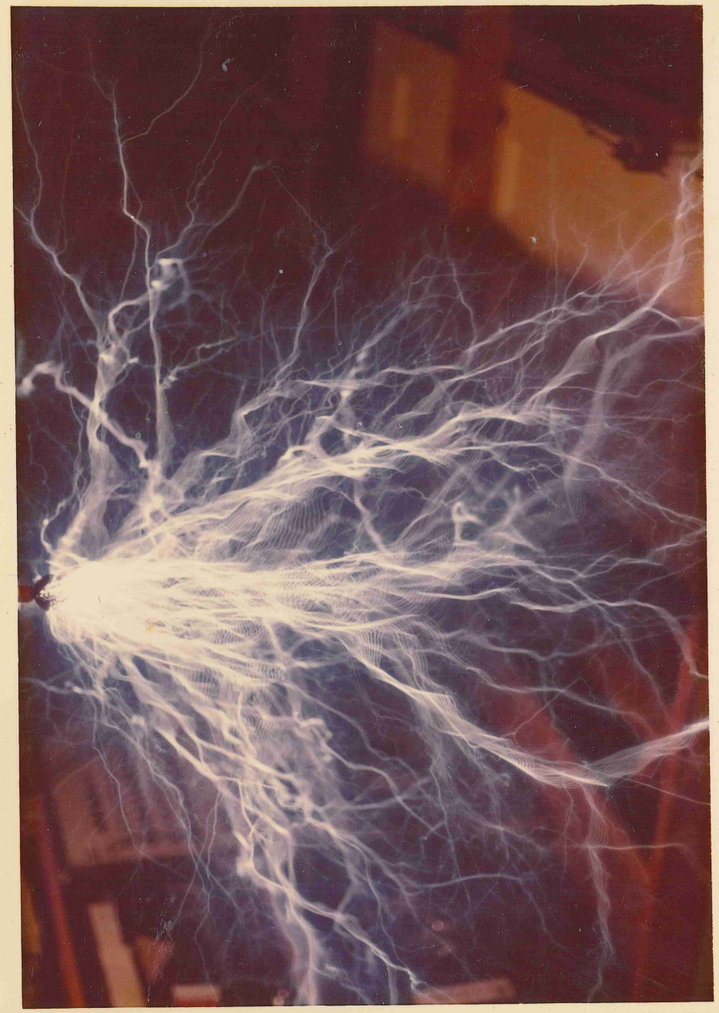


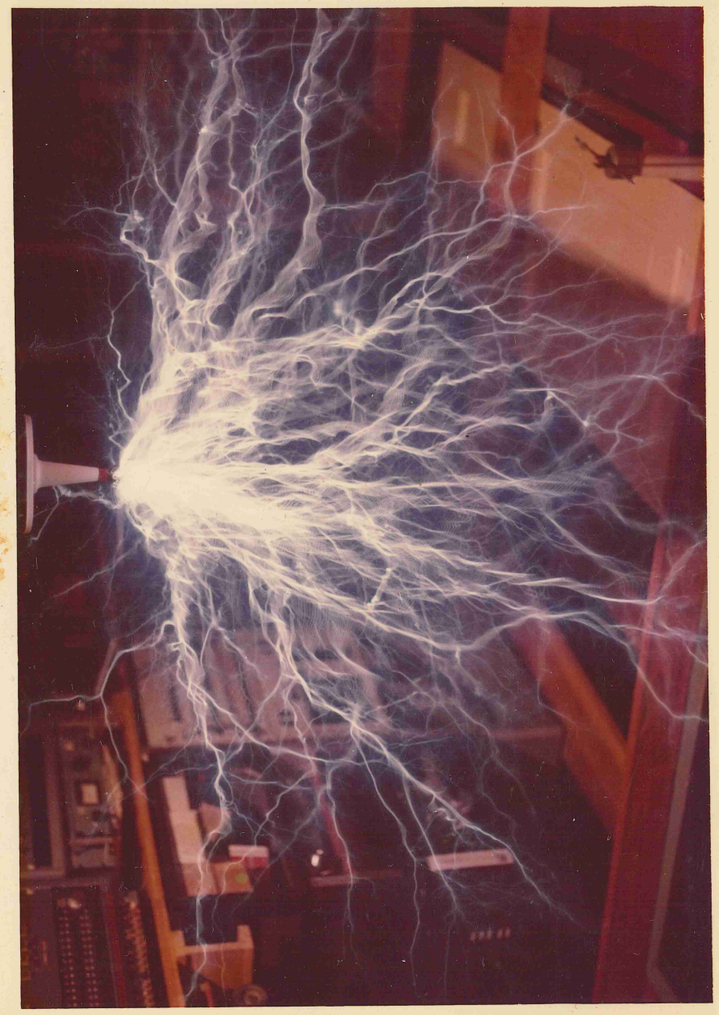
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



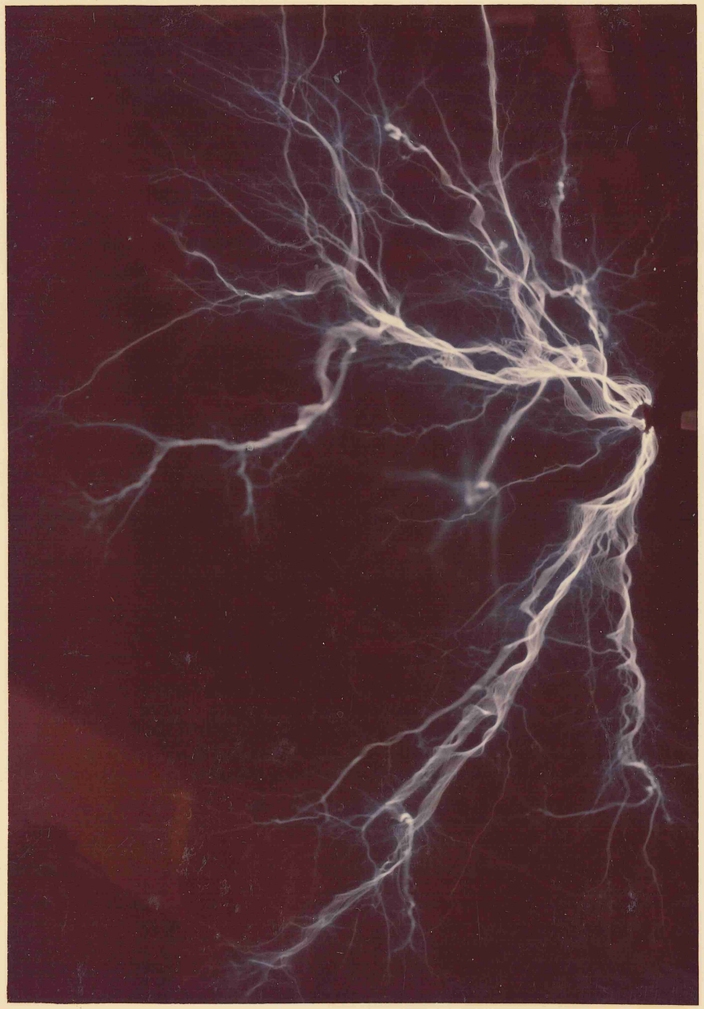


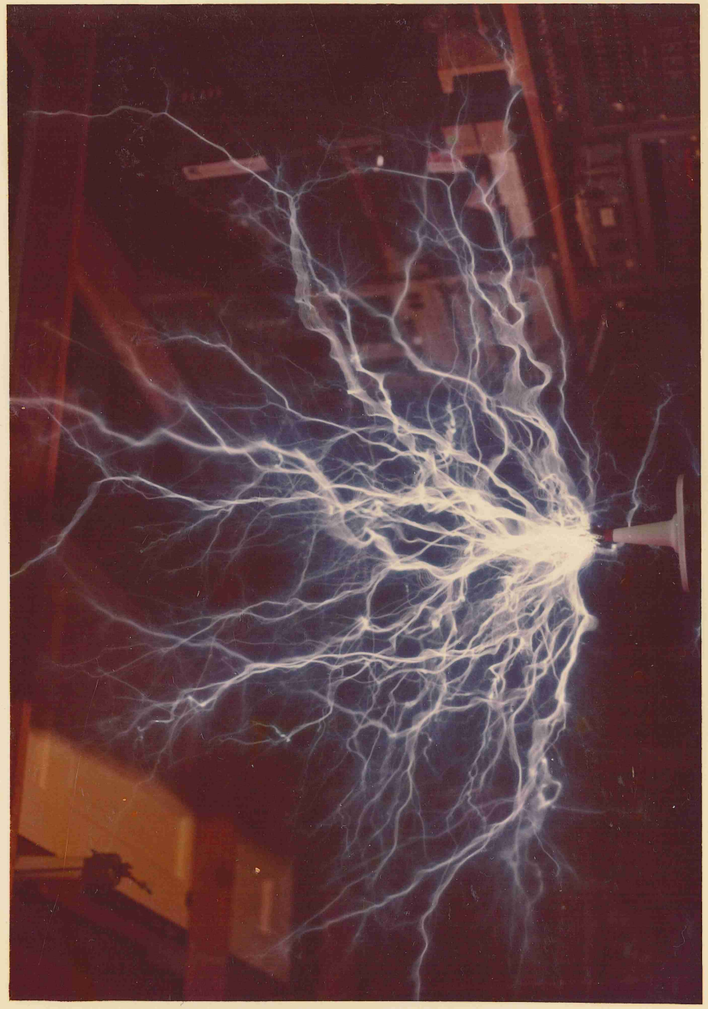
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum



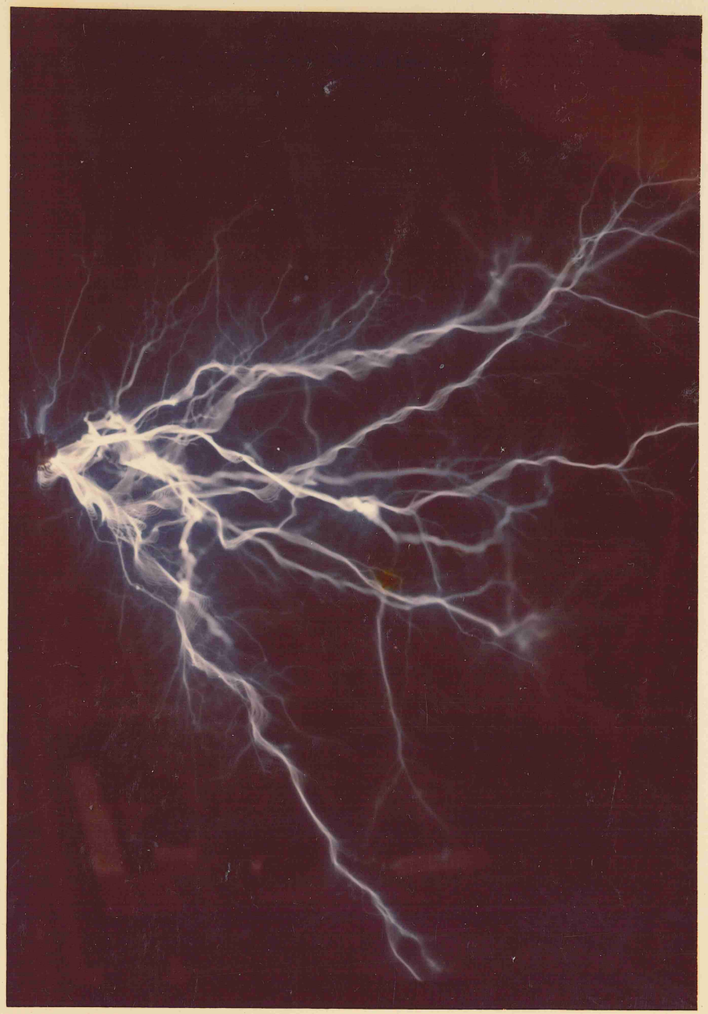


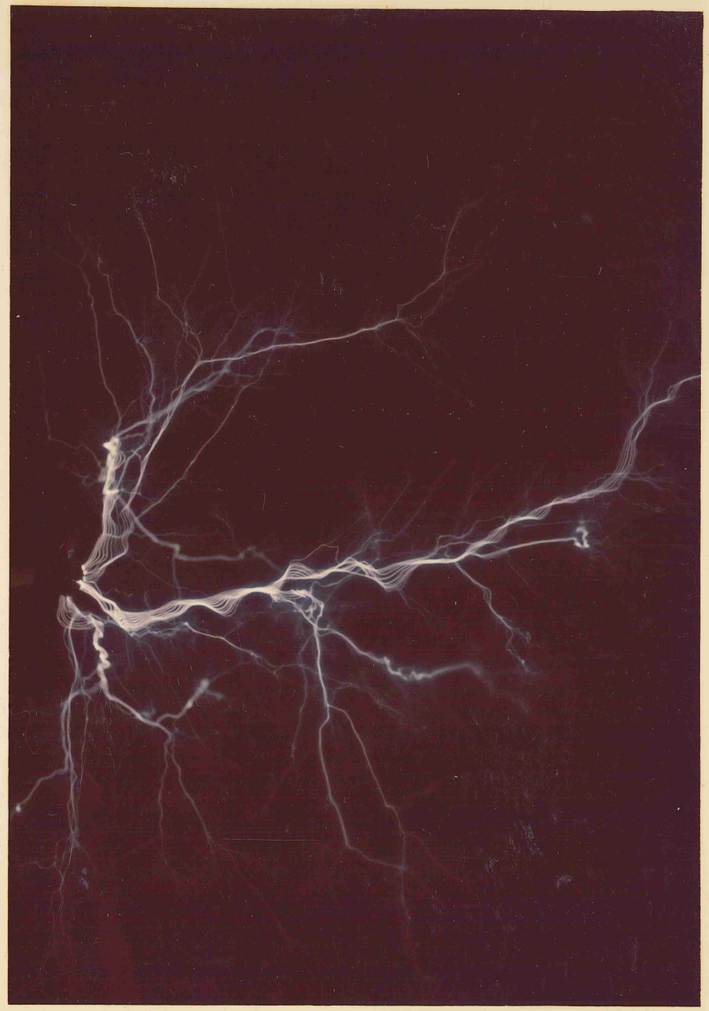
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





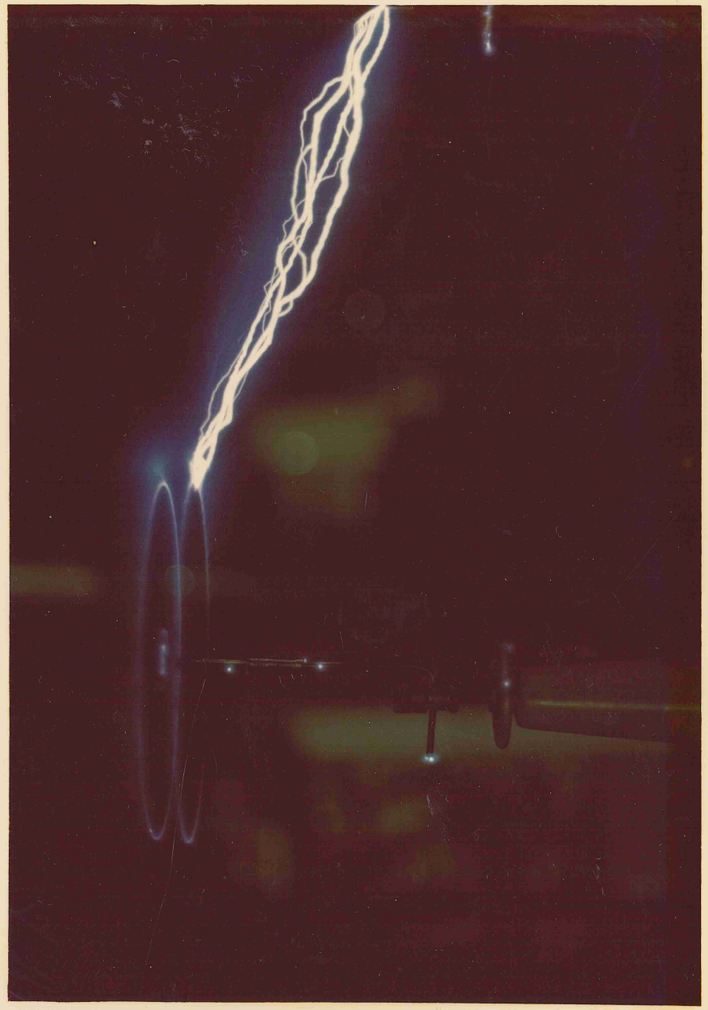
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





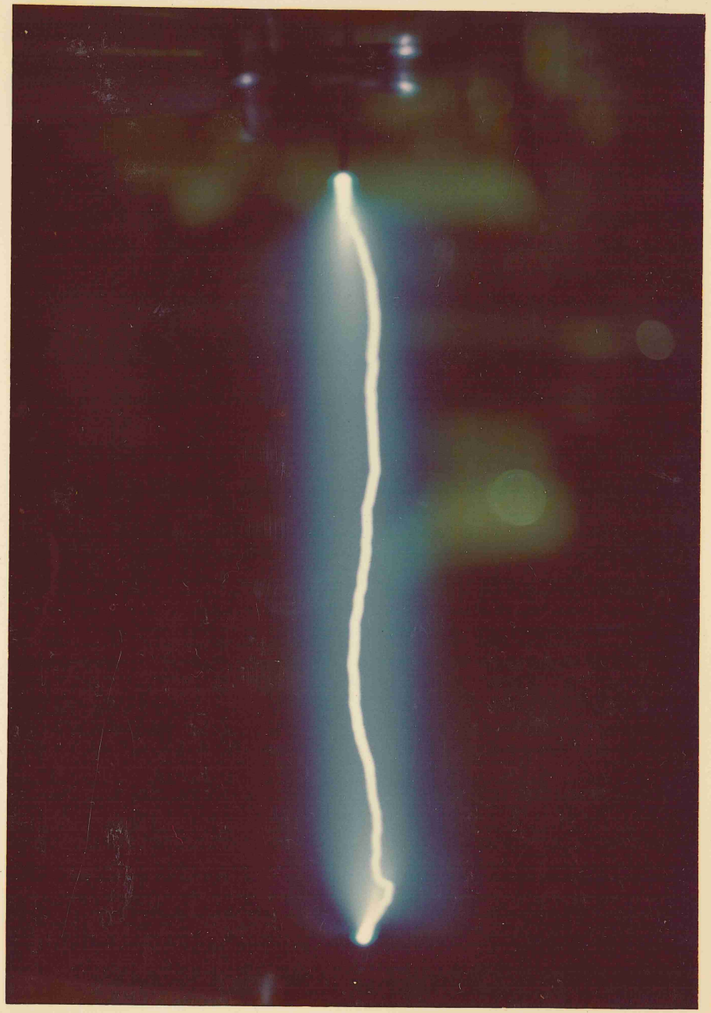
William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum





William C. "Bill" Wysock - Tesla Technology Research Archive - From the library of The Turn Of The Century Electrotherapy Museum