

IPR2024-00936
U.S. Patent No. 9,118,528
Patent Owner's Response

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TEXAS INSTRUMENTS INC.,
Petitioner,

v.

PARKERVISION, INC.
Patent Owner

U.S. Patent No. 9,118,528

Issue Date: August 25, 2015

Title: METHOD AND SYSTEM FOR DOWN-CONVERTING AN
ELECTROMAGNETIC SIGNAL, AND TRANSFORMS FOR SAME, AND
APERTURE RELATIONSHIPS

Inter Partes Review No. IPR2024-00936

**PATENT OWNER'S RESPONSE TO PETITION FOR *INTER PARTES* REVIEW
OF UNITED STATES PATENT NO. 9,118,528**

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TABLE OF AUTHORITIES

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Cases

<i>Intel Corp. v. ParkerVision, Inc.</i> , IPR2020-01265, Paper 44 (PTAB Jan. 21, 2022), <i>aff'd</i> , <i>ParkerVision, Inc. v. Vidal</i> , No. 2022-1548, slip op. (Fed. Cir. 2023).....	60
<i>Intel Corp. v. ParkerVision, Inc.</i> , IPR2021-00346, Paper 33 (PTAB July 20, 2022), <i>aff'd</i> , <i>ParkerVision, Inc. v. Vidal</i> , No. 2022-2173, slip op. (Fed. Cir. 2024).....	60
<i>ParkerVision v. Qualcomm</i> , 116 F.4th 1345 (Fed. Cir. 2024)	62, 88
<i>Plas-Pak Industries v. Sulzer Mixpac AG</i> , 600 Fed. Appx. 755 (Fed. Cir. 2013).....	107
<i>Runway Safe LLC v. Engineered Arresting Systems</i> , IPR2015-01921, Paper 9, 6-8, 10-11 (PTAB Feb. 29, 2016).....	100

PATENT OWNER'S EXHIBIT LIST

Exhibit No.	Description
2006	U.S. Patent No. 6,061,551
2007	Joint Claim Construction Statement, ParkerVision, Inc. v. Texas Instruments Inc., 6:23-cv-00384, Dkt. 50 (April 29, 2024)
2008	RESERVED
2009	UA741 datasheet
2010	Boeing Report dated April 29, 1998
2011	ParkerVision schematic dated January 20, 1998
2012	Eddie chip layout dated March 6, 1997
2013	ParkerVision circuit board layout
2014	ParkerVision schematic dated August 21, 1997
2015	Conception/Reduction to practice chart
2016	Declaration of David Sorrells
2017	RESERVED
2018	RESERVED
2019	ParkerVision Announces Breakthrough in Wireless Radio Frequency Technology
2020	Laboratory Tests Verify ParkerVision Wireless Technology
2021	Universal Direct Conversion Receiver Evaluation ASIC Contract between ParkerVision and The Boeing Company
2022	Notes from Boeing Tests
2023	RESERVED
2024	Declaration of Dr. David Ricketts
2025	Excerpts from Howe, R. et al., Microelectronics: An Integrated Approach
2026	RESERVED
2027	Development Agreement between ParkerVision and TriQuint Semiconductor dated March 4, 1997
2028	Default Protective Order
2029	Spreadsheet showing ParkerVision files
2030	Claim Construction Order dated 2/20/13 – No. 3:11-cv-00719 (MDFL)

2031	Excerpt of Graf, R., Modern Dictionary of Electronics, Seventh Edition
2032	Rofougaran, A., et al., A 1 GHz CMOS RF Front-End IC for a Direct Conversion Wireless Receiver
2033	RESERVED
2034	Deposition Transcript of Ian Galton, dated March 12, 2025
2035	Sedra, Microelectronic Circuits (4 th ed. 1998)
2036	ParkerVision's Disclosure of Additional Final Infringement Contentions, dated March 31, 2025.
2037	CMOS Analog Circuit Design

I. INTRODUCTION

The claims of U.S. Patent No. 9,118,528 (“’528 patent”) are directed to an energy transfer system for down-converting a radio signal.

Claims 1, 3, 5, 8-9, 11-18 of the ’528 patent were conceived and diligently reduced to practice no later than April 1998. Thus, Tayloe and Macnally are not prior art.

Notably, Petitioner is unable to demonstrate that Tayloe/TI Datasheet or Razavi disclose numerous claim elements. So Petitioner impermissibly redesigns Tayloe’s and Razavi’s circuits by replacing amplifiers (that were specifically selected so that Tayloe and Razavi operate to read voltages) with a completely different component—Macnally’s filter. In doing so, Petitioner changes the fundamental operation of Tayloe/TI Datasheet and Razavi.

In particular, Tayloe is a voltage sampling system, the goal of which is to down-convert a radio signal by accurately reading samples of the signal’s voltage. To accomplish this, Tayloe uses an amplifier with a high impedance to hold voltage samples on capacitors so that accurate voltages can be read. The high-impedance is required so that the held voltage from the sample is not changed by the circuit. Voltage sampling is premised on the reliance that the samples are the accurate, true reading of the voltage of the input when the sample was taken. Though Razavi uses a different type of technology, Razavi also seeks to accurately read voltages by using

an amplifier with a high impedance input. These voltage-based systems are different than the claimed energy transfer system, which transfers energy from the radio signal through the system and where the baseband signal is made up of the actual transferred energy itself.

Petitioner's proposed redesign essentially throws Tayloe's and Razavi's designs out the window and improperly replaces high impedance amplifiers with Macnally's filter, which Petitioner alleges is low impedance. Contrary to Tayloe's/Razavi's disclosure, using a low impedance circuit does not allow for accurate readings of voltage to recreate the baseband signal, which goes against the basic theory for voltage sampling.

Petitioner's combinations are nothing more than pure hindsight. In an attempt to replicate what is disclosed in the '528 patent, Petitioner uses the cited references to construct a new circuit that operates completely differently from Tayloe/Razavi. But, as discussed below, there is no motivation to combine the references as Petitioner has done, which is contrary to the intended operation of the references. Nor would the combination provide predictable results or have a reasonable expectation of success. Critically, Petitioner's proposed redesign is directly contrary to the stated goals/operation of Tayloe/Razavi.

Accordingly, Petitioner has failed to demonstrate that the challenged claims are invalid.

II. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA would have: (a) a BS degree in electrical or computer engineering (or a related academic field), and at least two (2) additional years of work experience in the design/development of radio frequency circuits and/or systems, or (b) at least five (5) years of work experience and training in the design/development of radio frequency circuits and/or systems. Ex.-2024, ¶30.

III. TECHNOLOGY BACKGROUND

A. Circuit concepts¹

Dr. Ricketts explains various circuit concepts.

B. Circuit Components

1. Transistor²

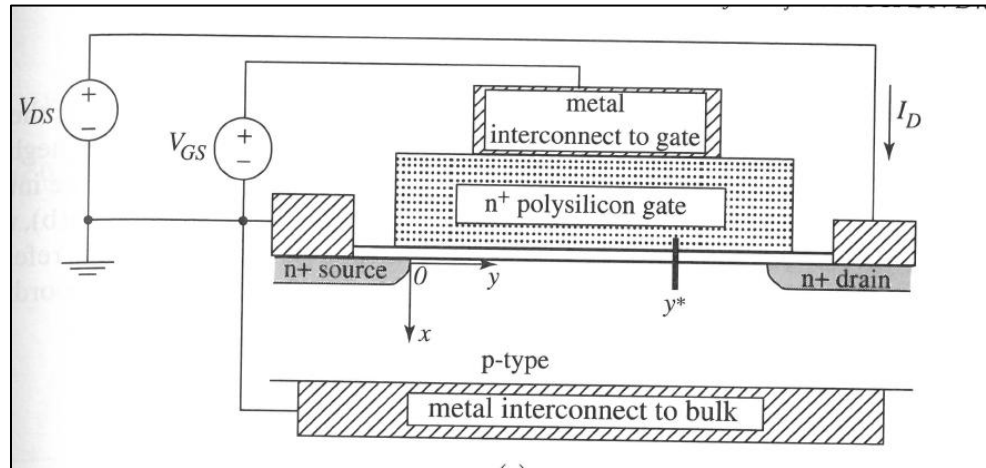
A transistor is a semiconductor device used to switch, detect, or amplify electronic signals and electrical power.

¹ Ex.-2024, ¶¶43-52.

² Ex.-2024, ¶¶54-60.

2. NMOS transistors³

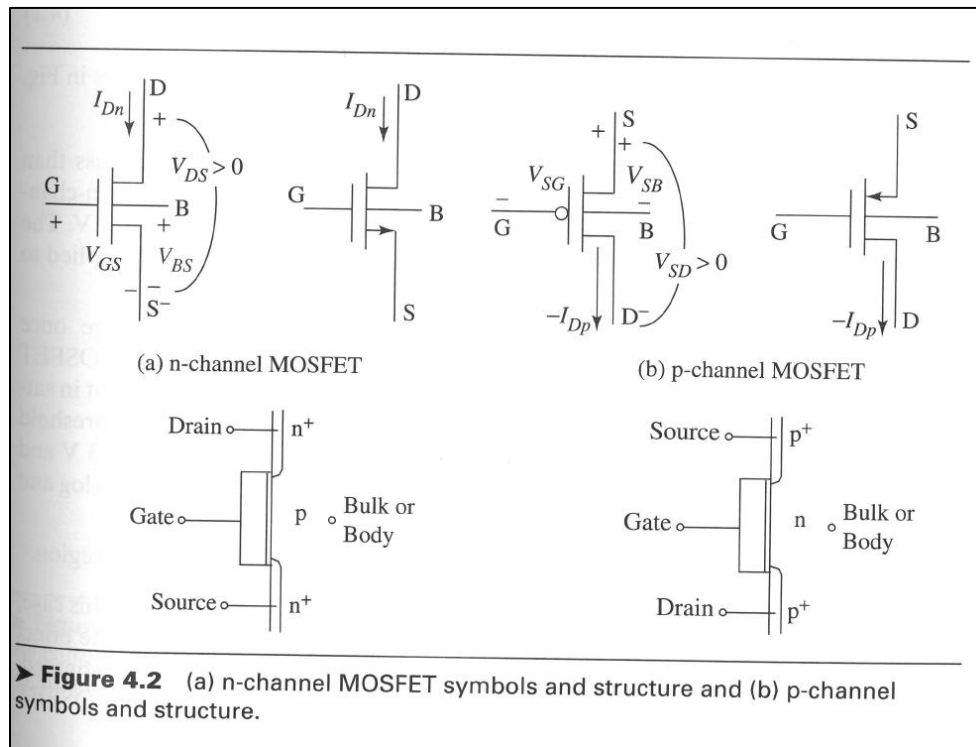
In a NMOS FET, current flow from the drain (D) to the source (S) is controlled by the voltage at the gate (G).



Ex.-2025, 199.

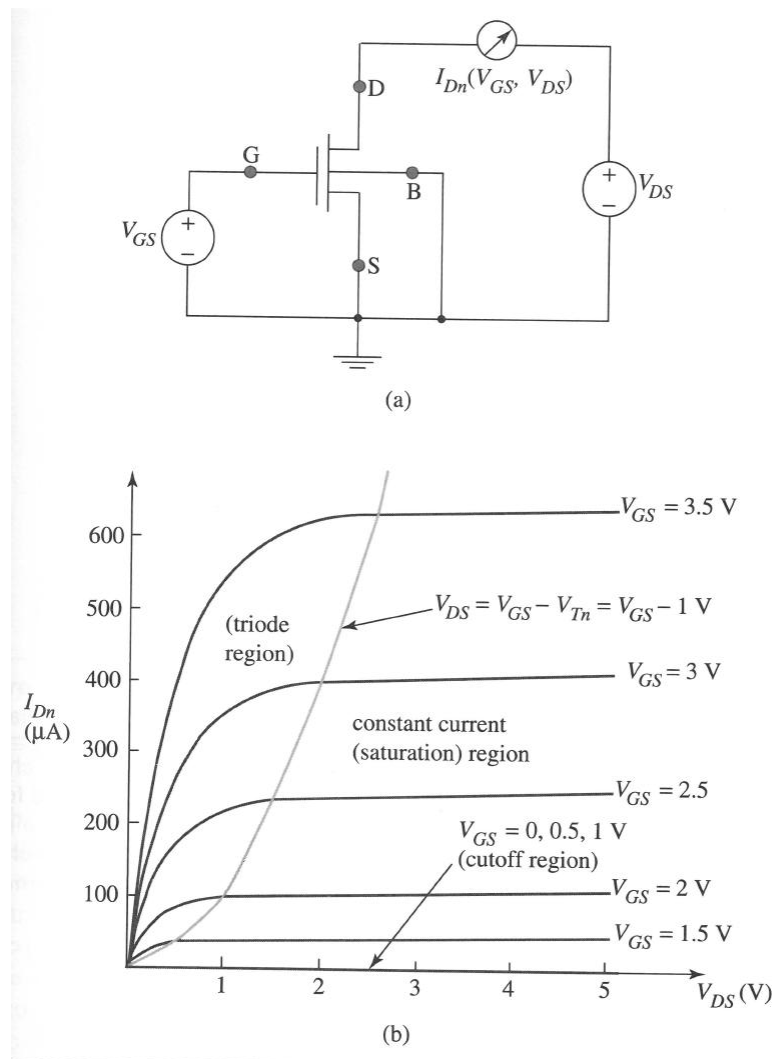
The symbols for a n-channel and p-channel MOSFETs are shown below.

³ Ex.-2024, ¶¶61-68.



Ex.-2025, 195.

NMOS MOSFETs have two primary regions of operation: (1) triode region and (2) saturation region (shown below).



Ex.-2025, p. 197.

In saturation, the current flows only from the drain to the source (unidirectional).

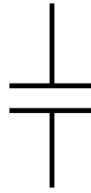
3. Resistor

A resistor is a circuit element that introduces resistance into a circuit. Ex.-
2024, ¶¶69-71.



4. Capacitor

A capacitor is one type of circuit element used to accumulate energy. Ex.-2024, ¶¶72-78.



5. Electrical Load⁴

An electrical load is an electrical element or portion of a circuit that absorbs power and converts it into a desired form. A resistor is a type of load.

There are high impedance loads and low impedance loads. A high impedance load inhibits current from moving in a circuit. A low impedance load provides little constraint to current moving in a circuit and absorbs electrical energy.

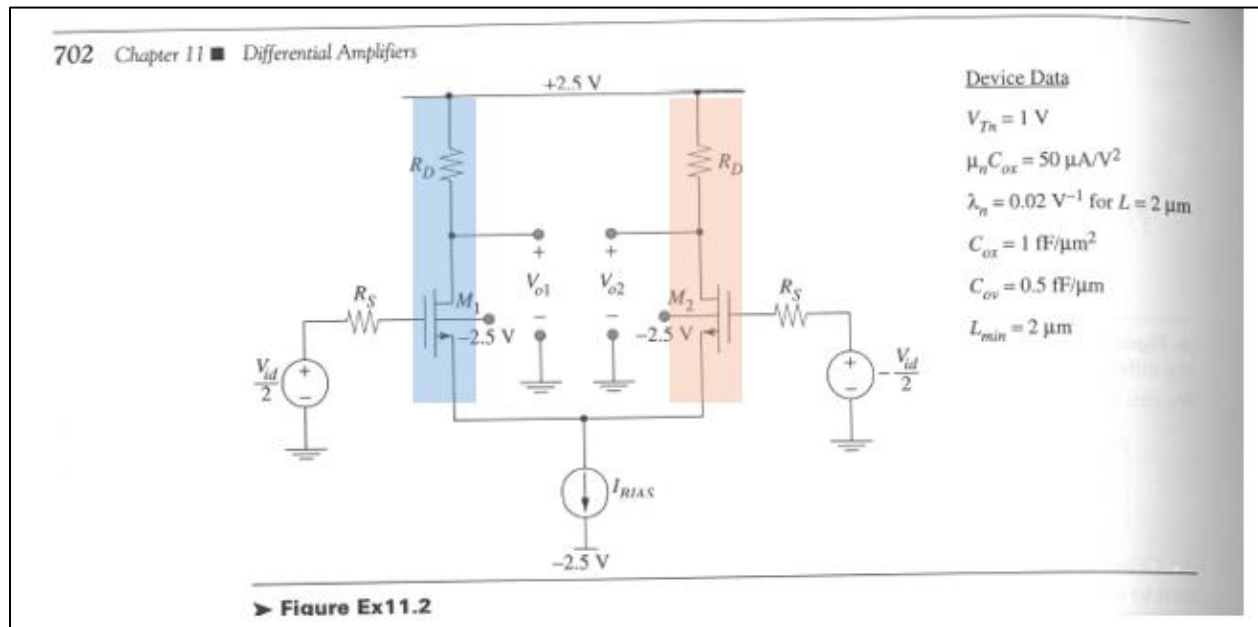
6. Local Oscillator

A local oscillator is used to create an LO signal. Ex.-2031, p. 5. Ex.-2024, ¶¶82-86.

⁴ Ex.-2024, ¶¶79-81.

7. Differential Amplifiers⁵

A differential amplifier circuit amplifies a differential input signal using a “differential pair,” which consists of a pair of transistors (see below).



Ex.-2025, 702.

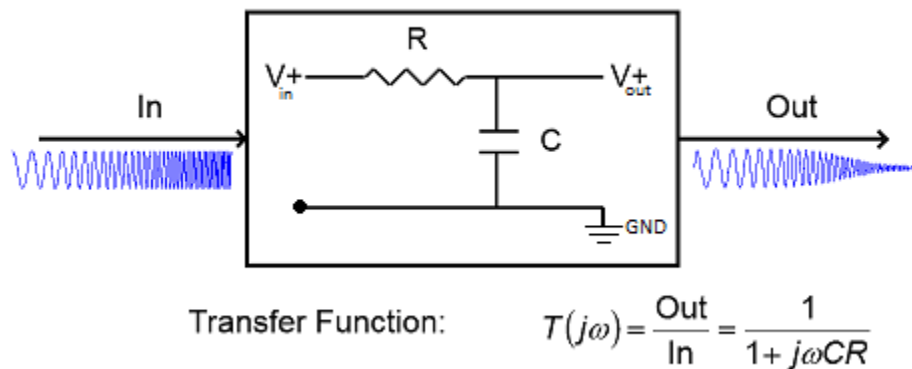
The differential input voltage (V_{id}) steers the current I_{BIAS} between the two branches (blue, red).

8. Low-pass Filter⁶

A low pass filter is a circuit that attenuates high-frequency signals while allowing low-frequency signals to pass through.

⁵ Ex.-2024, ¶¶87-93.

⁶ Ex.-2024, ¶¶94-95.



In the simple RC filter above, filtering is achieved due to the frequency-dependent impedance of the capacitor, C.

9. Sampling⁷

Sampling is the process of taking a continuous time signal and converting it to a discrete time signal.

IV. DOWN-CONVERSION SYSTEMS

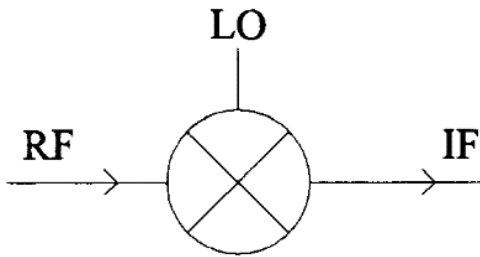
There are two types of down-conversion technology: (1) non-sampling/heterodyning; and (2) sampling-based down-conversion. Ex.-2024, ¶¶98.

A. Heterodyning (Non-Sampling)

Heterodyne receivers use non-sampling mixers that operate by continuously multiplying two sinusoidal signals—an incoming RF signal with a local oscillator (LO) signal. Ex.-2024, ¶¶99-101.

⁷ Ex.-2024, ¶¶96-97.

The typical symbol for a mixer is shown below.



A mixer converts a signal received at one frequency to another frequency. A local oscillator sends a signal to the mixer to effect down-conversion. Ex.-2024,¶¶102-111.

B. Sampling

Sampling-based down-conversion uses switches to capture discrete samples of the RF signal at specific time intervals. Ex.-2024,¶112.

Sampling-based down-conversion systems can be categorized into: (1) voltage sampling systems, and (2) energy transfer (energy sampling) systems. Ex.-2024,¶113.

1. Voltage sampling

In the late 1980s through 2000, a technology being considered for direct down-conversion was sample-and-hold (voltage sampling). Ex.-2024,¶¶114-117.

A voltage sampling system captures discrete voltage readings on a capacitor and recreates the baseband signal based on those voltage readings. A high impedance load is used to hold the voltage on a capacitor during each sample. The high

impedance load prevents the capacitor from discharging so that an accurate reading of voltage can be taken. Ex.-2037, pp. 523-524. Without a high impedance load, the voltage on the capacitor would fluctuate, thereby defeating the fundamental purpose of voltage sampling. Without an accurate reading of the voltage, the baseband signal cannot be accurately recreated (the system would not work). Transferring any energy out of the capacitor does not allow for an accurate reading of the voltage. Each sample of a voltage sampling circuit is independent from the previous sample. Energy does not become part of the baseband signal; instead, energy is effectively thrown away and wasted. Ex.-2024, ¶118.

2. Energy Sampling

Energy transfer (energy sampling) was/is a fundamentally different and competing method to voltage sampling. Energy samplers do not attempt to replicate or sample the voltage of an RF signal. Ex.-2024, ¶¶119-120.

In ParkerVision's energy transfer system, non-negligible amounts of energy from an input signal (a radio frequency (RF) signal) pass through the switch and the energy transferred itself to a load forms the down-converted (baseband) signal. In an energy transfer system, energy is integrated in a storage module (e.g., capacitor) and a low impedance load is used. This configuration allows energy to continuously flow to the low impedance load and forms the baseband signal. Energy flows from the

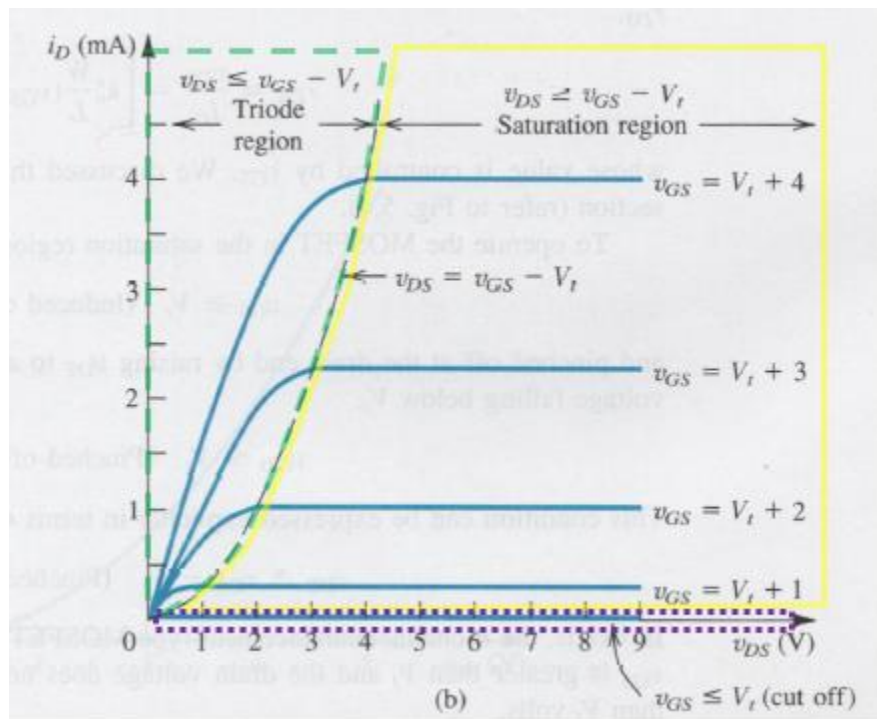
switch when the switch is closed (ON) and from the storage module when the switch is opened (OFF). Ex.-2024, ¶121.

If the capacitor did not continue to drive the low impedance load, the energy transfer system would not work properly, and information would be lost. Ex.-2024, ¶¶122-123.

Energy sampling is an accurate way to form a baseband signal. What ParkerVision realized, and others did not, was that accurately capturing the voltage of the RF signal is not critical; it was actually undesirable. ParkerVision realized that using most or all of the available energy from the RF signal was the best way to form the baseband signal. Moreover, the baseband signal carries significant power because non-negligible energy is discharged from the capacitor for driving a low impedance load. Ex.-2024, ¶¶124-126.

V. OPERATION OF FETS

The function a FET performs depends on how it is configured within a circuit. Ex.-2024, ¶¶124-132.



Ex.-2035, 367.

One type of FET is a MOSFET having distinct regions of operation: (i) cutoff region (purple); (ii) triode region (green); and (iii) saturation region (yellow). Ex.-2024, ¶¶133-137.

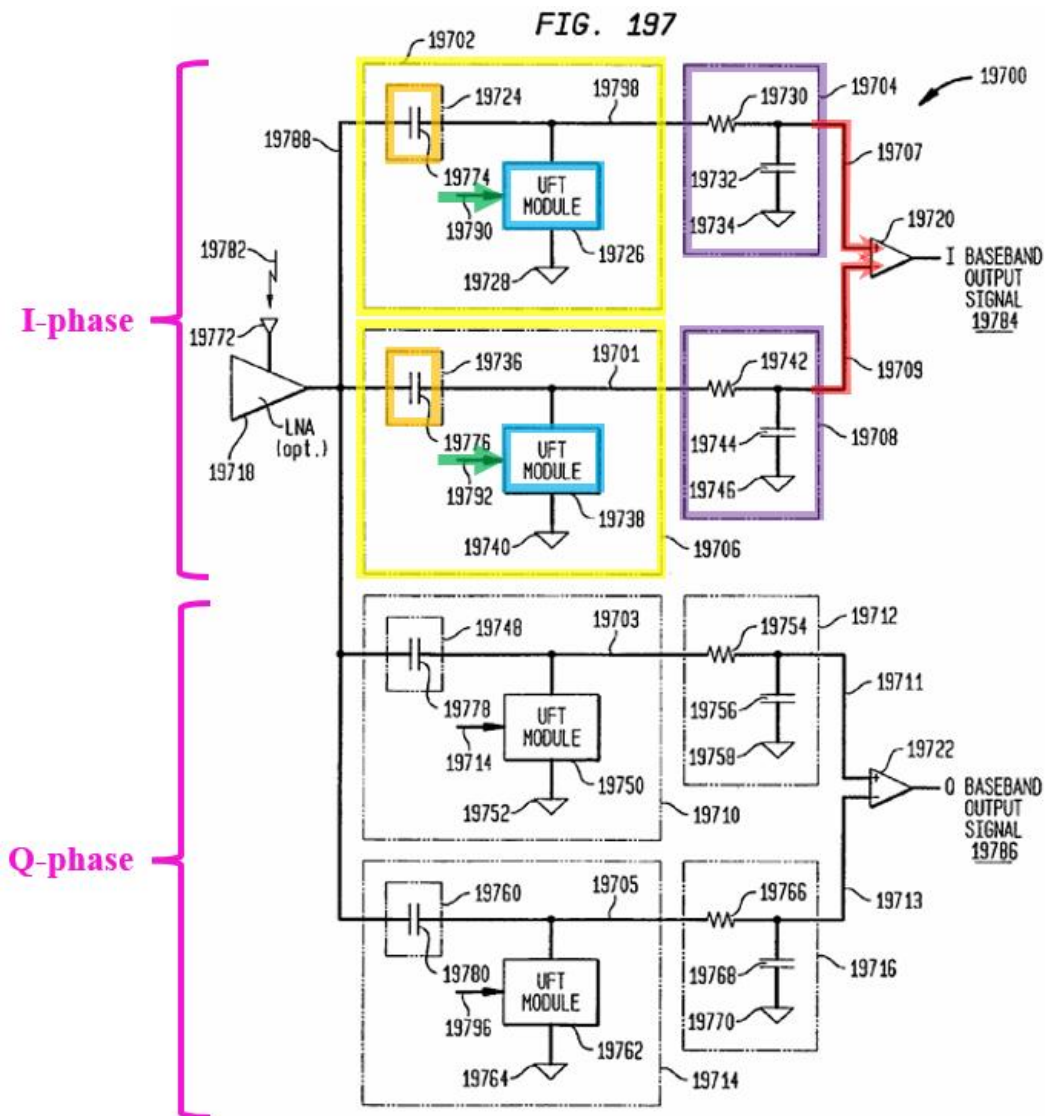
VI. U.S. PATENT NO. 9,118,528**A. Overview⁸**

Figure 197 (above) illustrates a type of I/Q modulation receiver 19700. Ex.-1001, 176:38-39. The receiver 19700 receives, down-converts, and demodulates an

⁸ Ex.-2024, ¶¶138-150.

I/Q modulated RF input signal 19782 to I/Q baseband output signals 19784, 19786, respectively. *Id.*, 176:47-50.

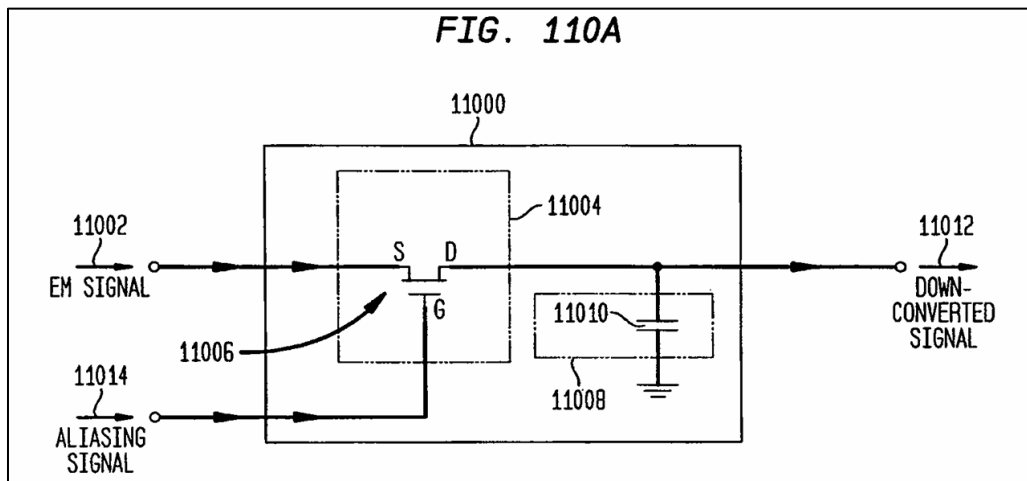


Figure 110A shows a UFT module 11004 that includes a FET/switch. *Id.*, 108:23-33.

The '528 patent discloses that the differential amplifier 19720 can have a differential baseband signal/differential output. *See id.*, Figures 76A-C, 76E; 119:10-120:55.

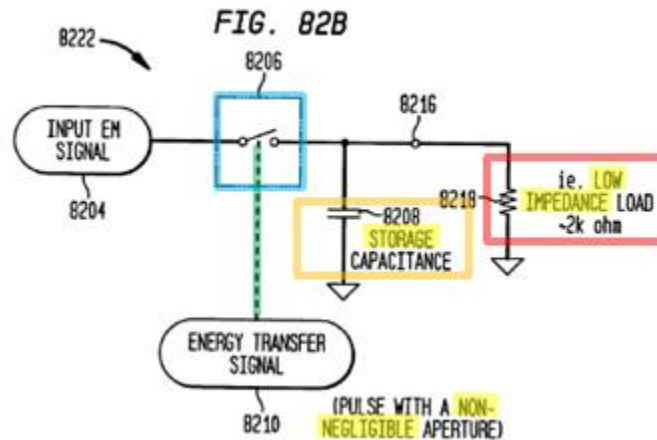
B. Down-conversion systems in the '528 patent

The '528 patent discloses two systems for down-conversion: (1) energy transfer (energy sampling) and (2) sample-and-hold (voltage sampling). Ex.-2024,¶152, 154.

The claims of the '528 patent are directed to an energy transfer system. *See* Section VII.C; Ex.-2024,¶153.

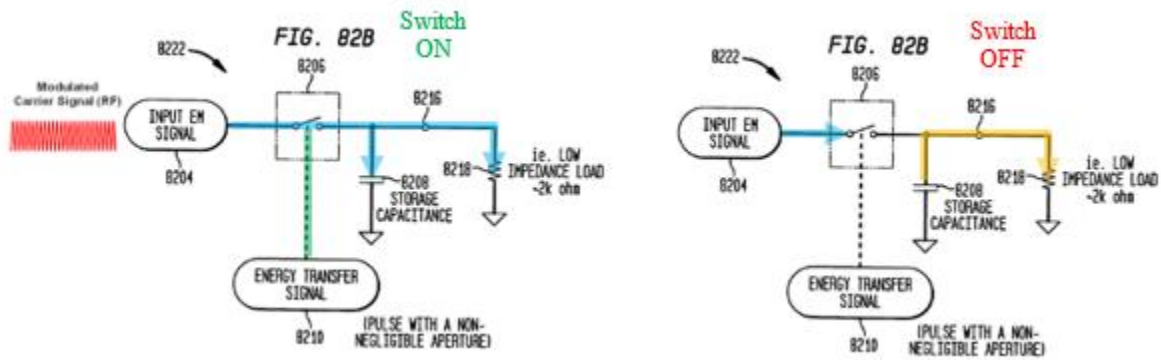
1. Energy Transfer (energy sampling)⁹

Figure 82B of the '528 patent (below) illustrates an energy transfer system.

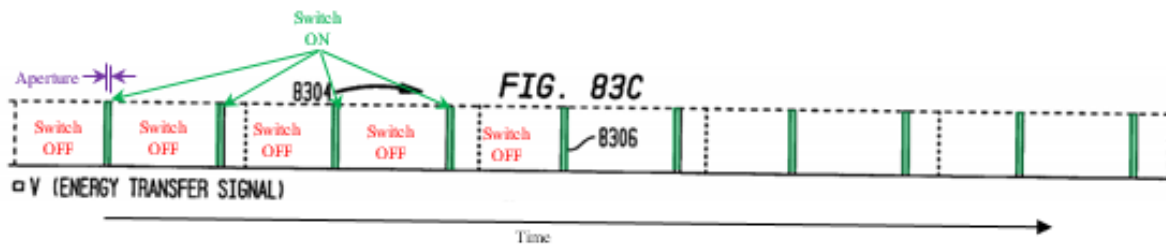


The system includes a switch 8206 (blue), an energy transfer signal 8210 (green) for controlling the switch, a “storage” capacitor, a low impedance load (red). A low impedance is what enables a storage capacitor to discharge its energy when the switch is OFF (open).

⁹ Ex.-2024, ¶¶155-163.



The annotations in Figure 82B above illustrate how an energy transfer system down-converts a high frequency input EM signal 8204 (e.g., modulated carrier signal (red)) to a baseband signal. In particular, down-conversion occurs by repetitively opening and closing the switch 8206.



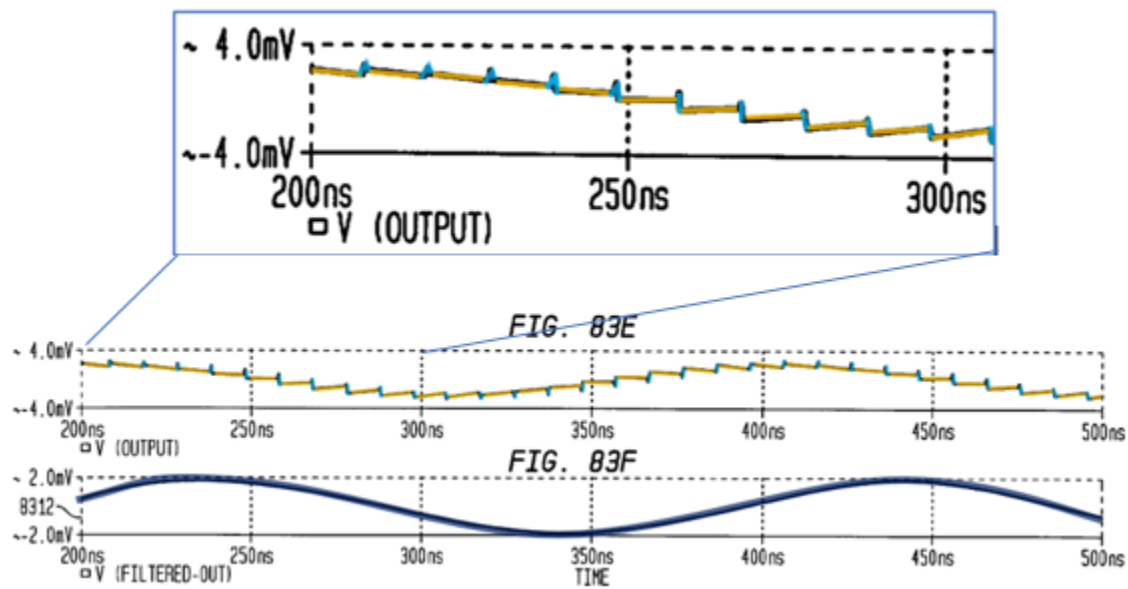
As shown in Figure 83C above, the switch is turned ON (closed) by sending a pulse 8306 (green) to the switch. The switch is kept ON (kept closed) for the duration of the pulse (i.e., a non-negligible aperture (purple) of the pulse). As shown by the repetitive pulses 8306, this opening and closing of the switch repeats continuously over time.

FIG. 83E

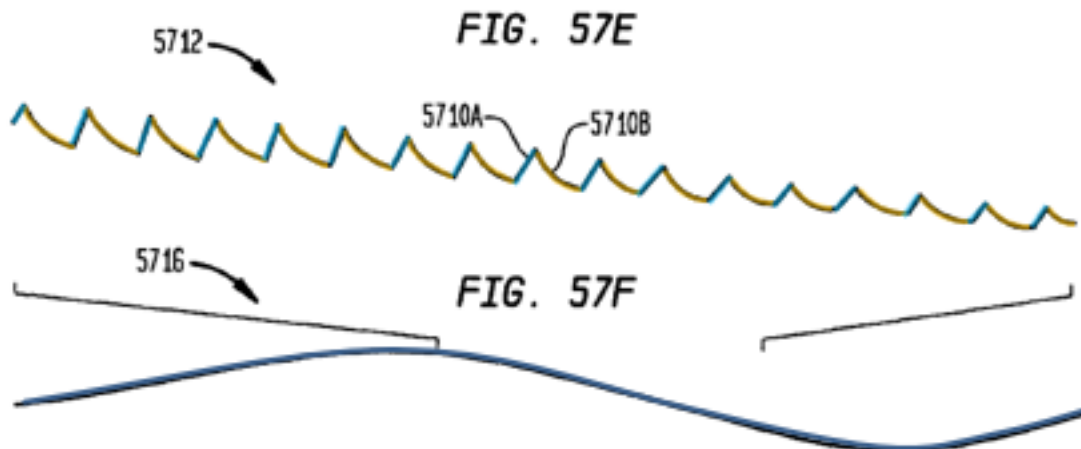
4.0mV
-4.0mV
200ns 250ns 300ns 350ns 400ns 450ns 500ns
V (OUTPUT)

18

up of energy (blue) from the EM signal and discharged energy (orange) from the “storage” capacitor.

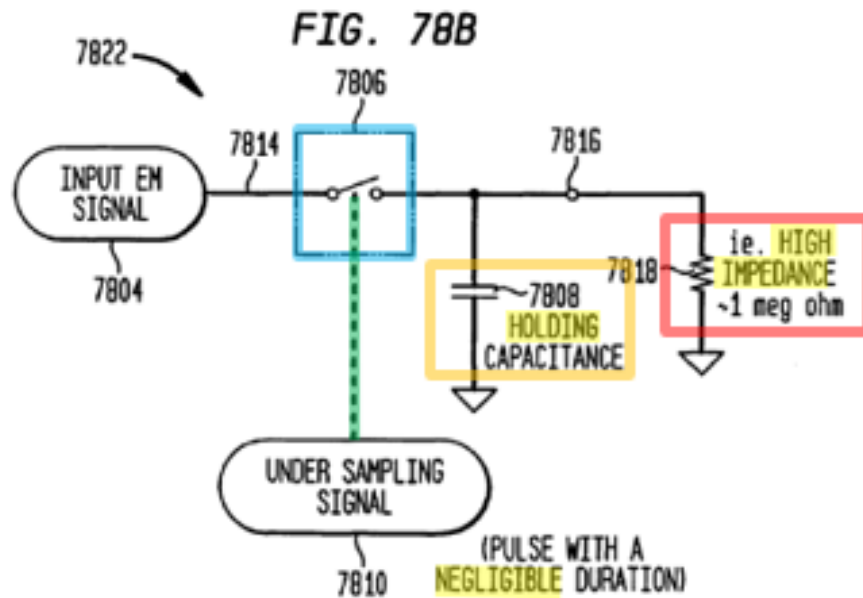


The figures below illustrate a close-up view of another embodiment of a down-converted signal in an energy transfer system.



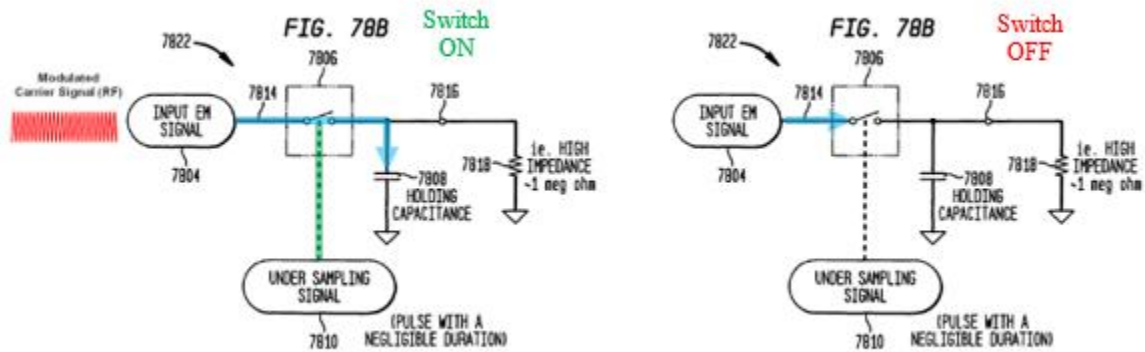
2. Sample-and-hold (voltage sampling)¹⁰

Figure 78B of the '528 patent illustrates a voltage sampling system.

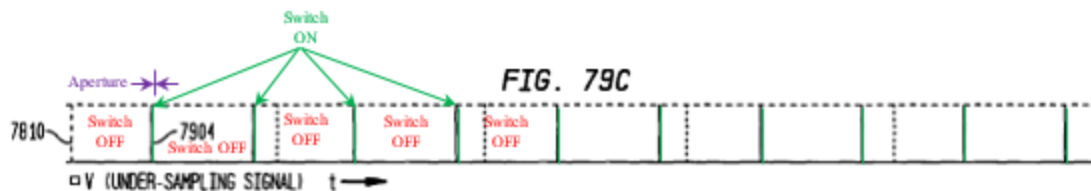


The system includes a switch 7806 (blue), a control signal 7810 (green) for controlling the switch, a “holding” capacitor 7808 (orange) for holding a voltage across the capacitor, and a high impedance load (red). A high impedance load is specifically included to prevent the holding capacitor from discharging energy.

¹⁰ Ex.-2024, ¶¶164-171.



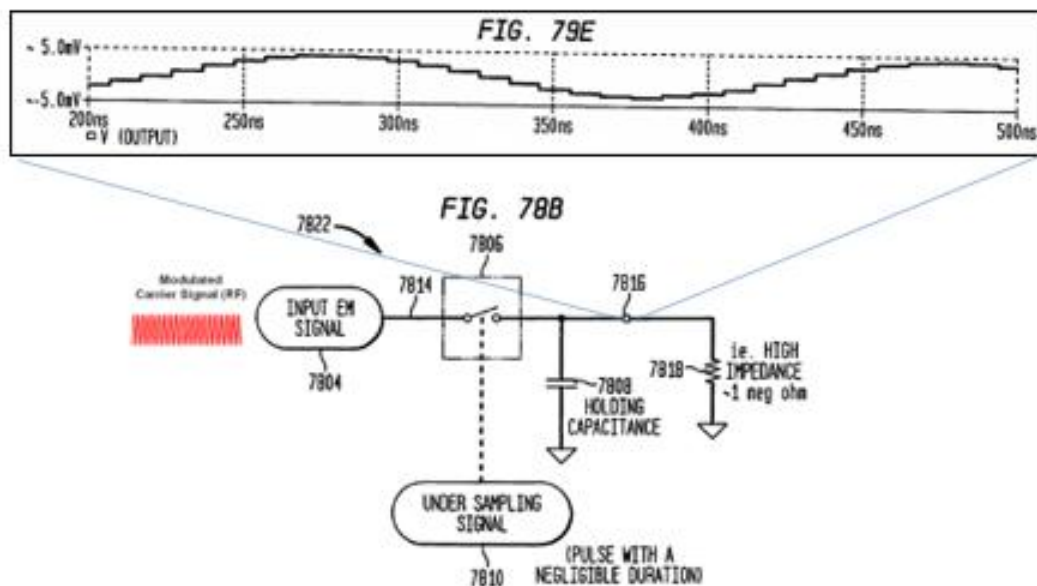
The annotations in Figure 78B illustrate how a sample and hold system down-converts a high frequency input EM signal 7804 (e.g., modulated carrier signal (red)) to a baseband signal.



As shown in Figure 79C, the switch is turned ON (closed) by sending a pulse 7904 (green vertical line) of an extremely short/negligible duration to the switch. Thus, the aperture (purple) of a pulse is referred to as a negligible aperture because the pulse width “tend[s] toward zero time.” Ex.-1001, 70:19-21. As shown by the repetitive pulses 7904, this opening and closing of the switch repeats continuously over time.

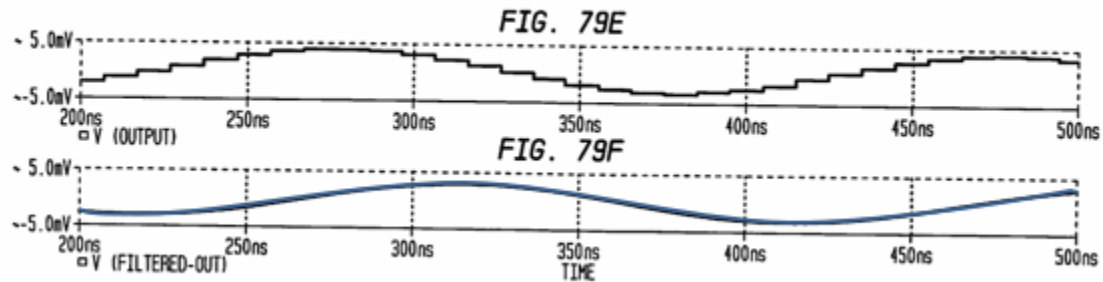
As shown in Figure 78B above, when the switch is ON (closed) (during the aperture), the EM signal 8204 (blue) is sent to the “holding” capacitor 7808. When the pulse 7904 (green) stops, the switch is turned OFF (opened). Because sample and hold uses a high impedance load, when the switch is OFF (opened), there is high resistance to the flow of current.

Because there is no significant energy discharge between pulses, the terminal 7816 maintains a constant voltage value until the next pulse. *Id.* at 64:21-26. The voltage value serves as the “sample” of a discrete voltage value that the system uses to recover the baseband signal.



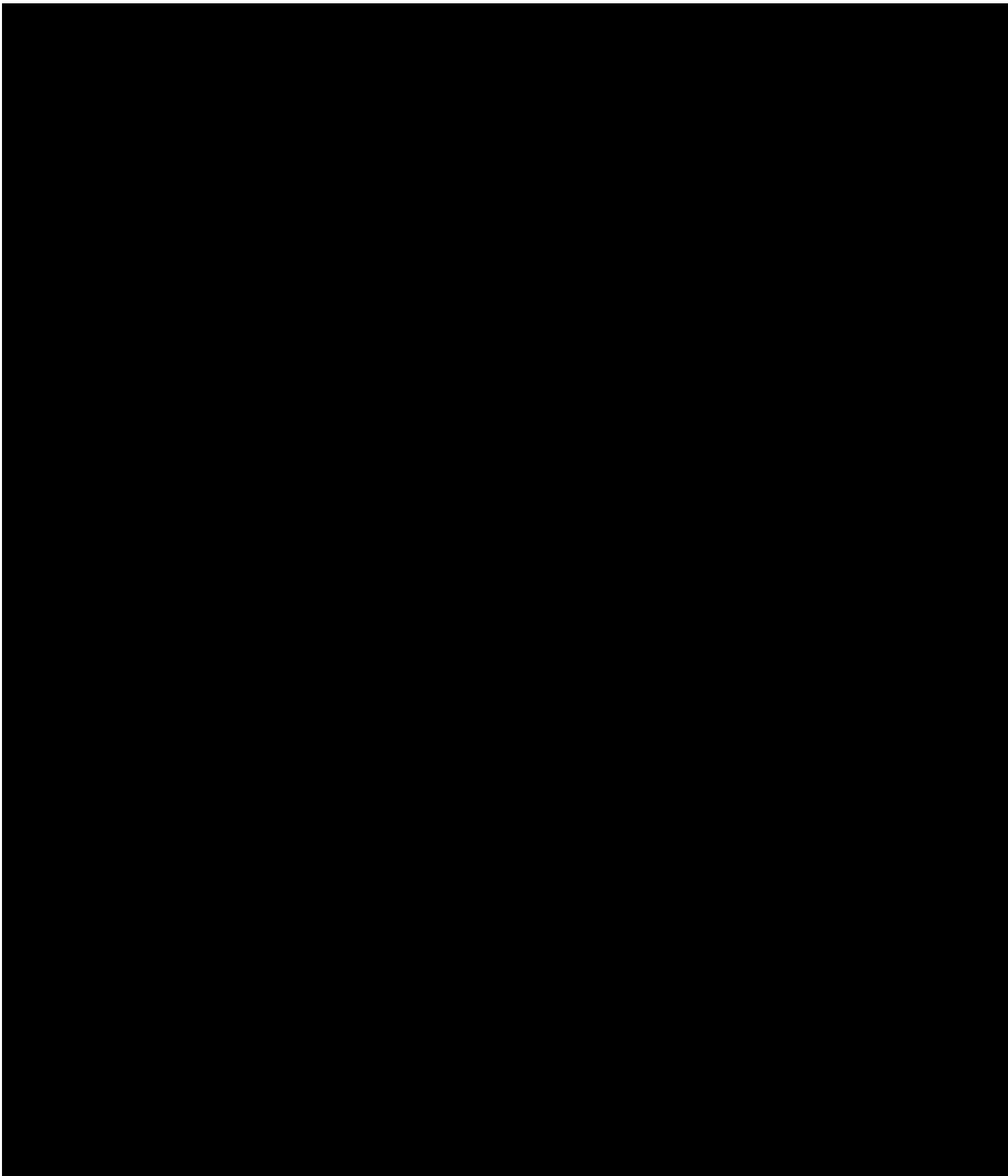
As shown in Figure 79E, sample and hold produces a voltage wave with a stair step pattern. The vertical part of the step represents the “sample” of the voltage value which occurs at the time of pulse 7904. The horizontal portion of the step

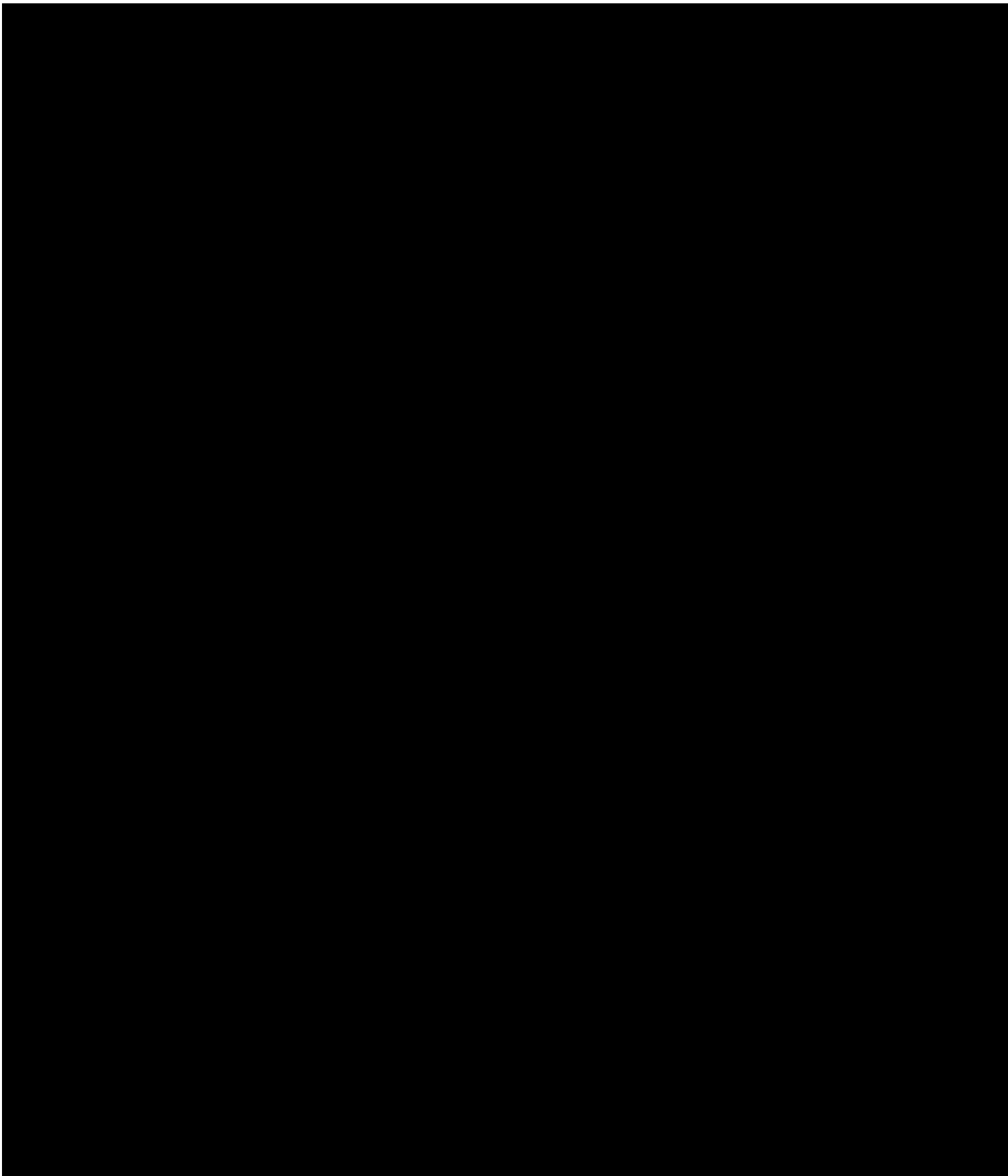
represents the “holding” of that voltage value until the next pulse when the next sample of voltage is taken. *Id.* at 64:26-30.

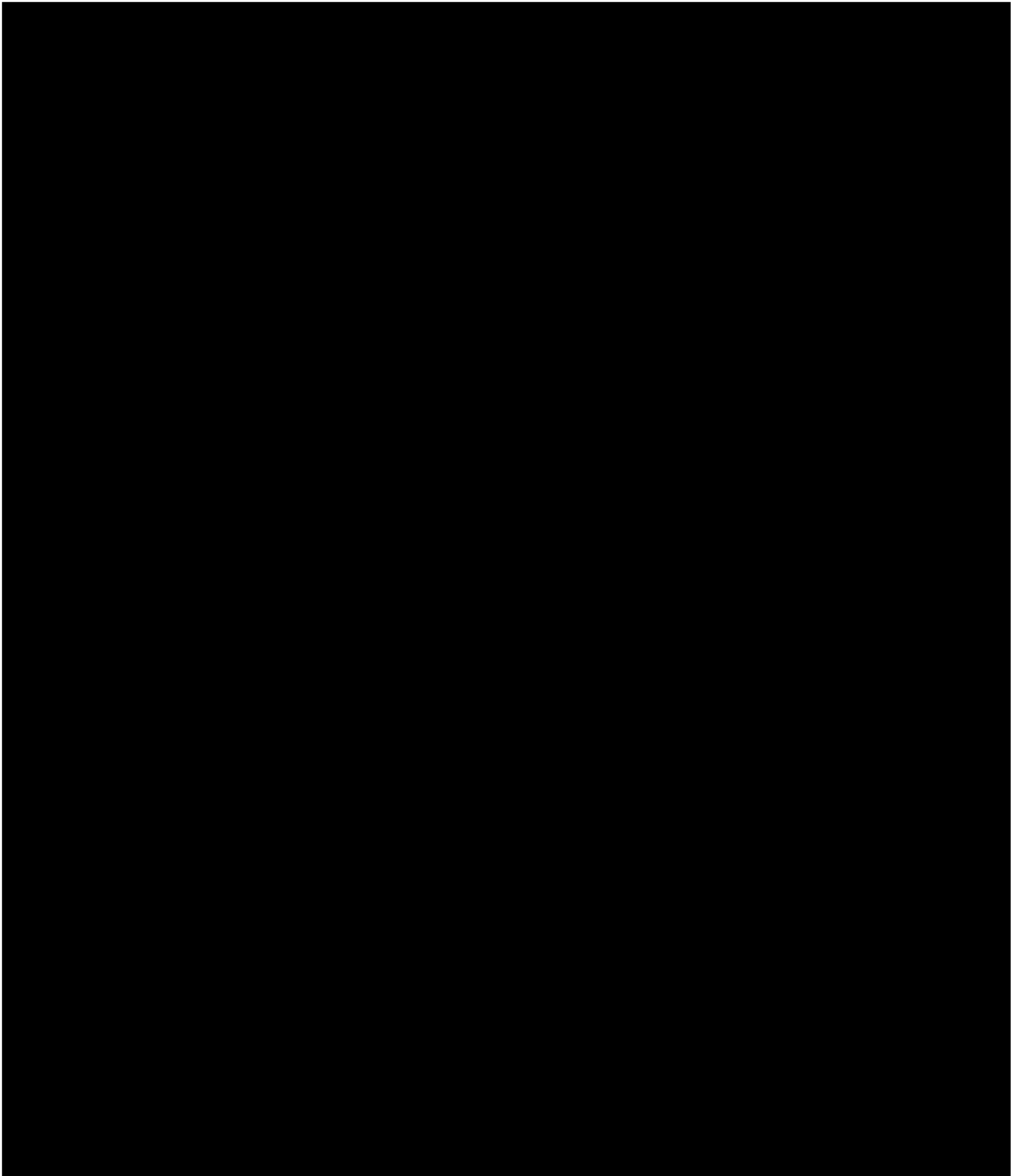


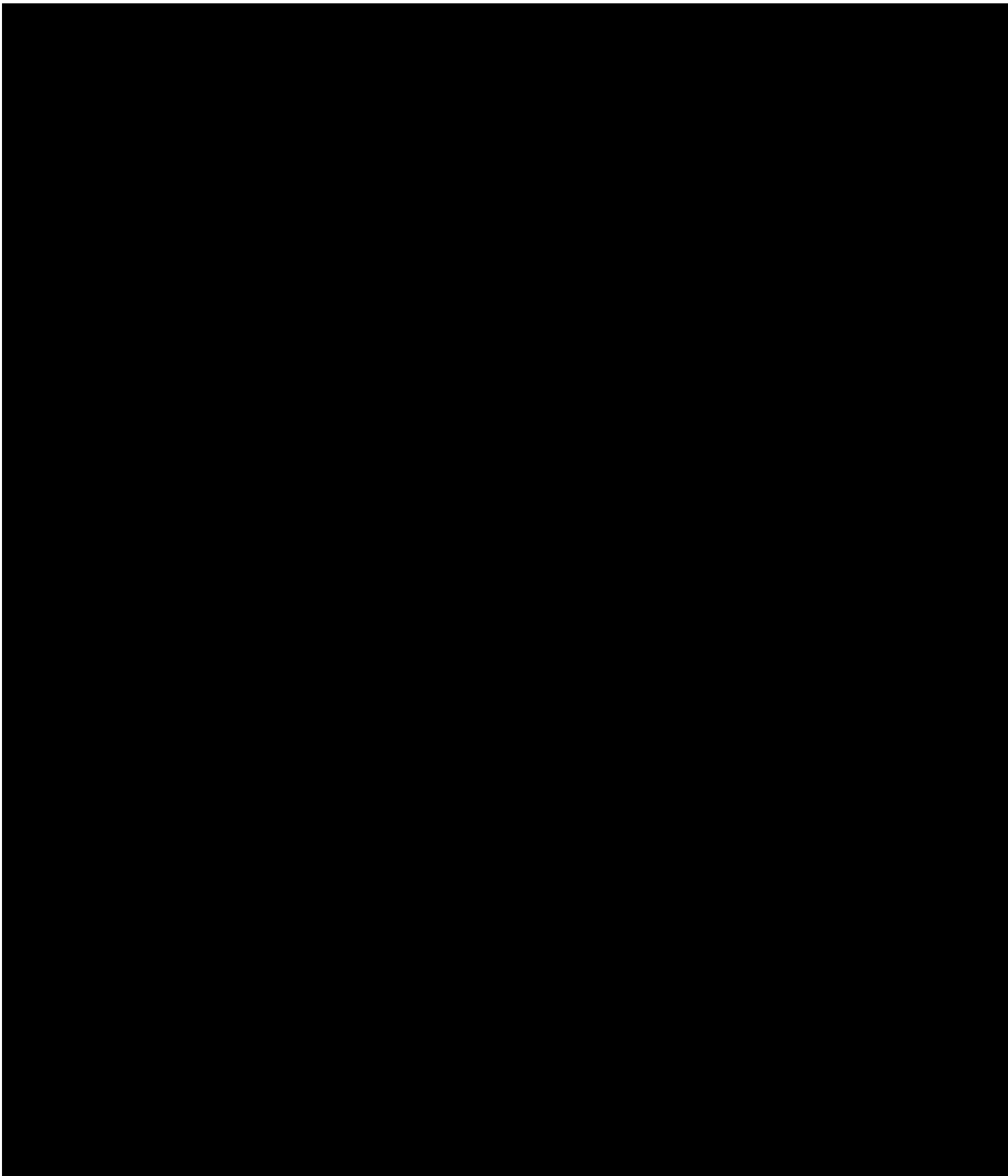
C. Conception/Reduction to Practice¹¹

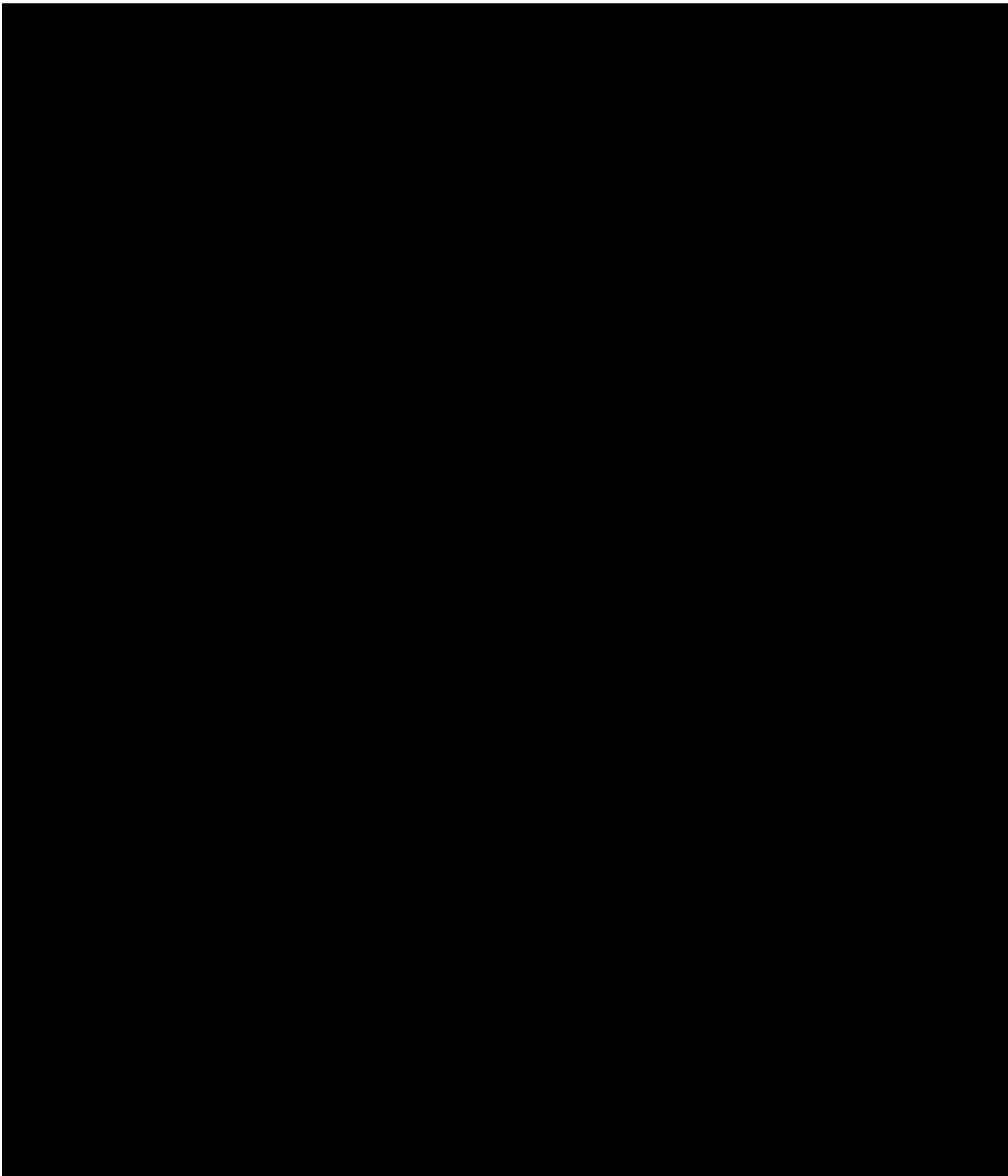
¹¹ See Ex.-2024, ¶172.

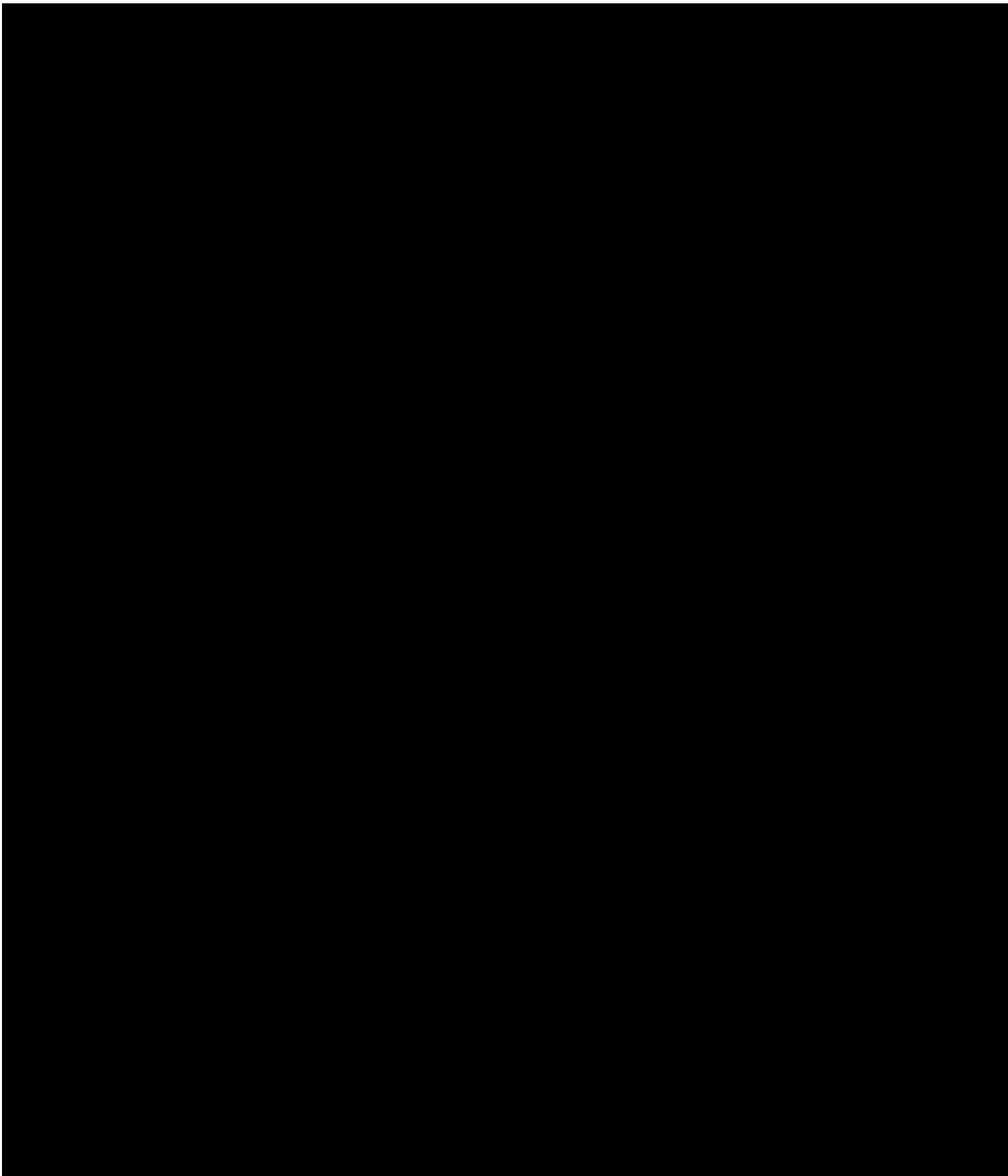


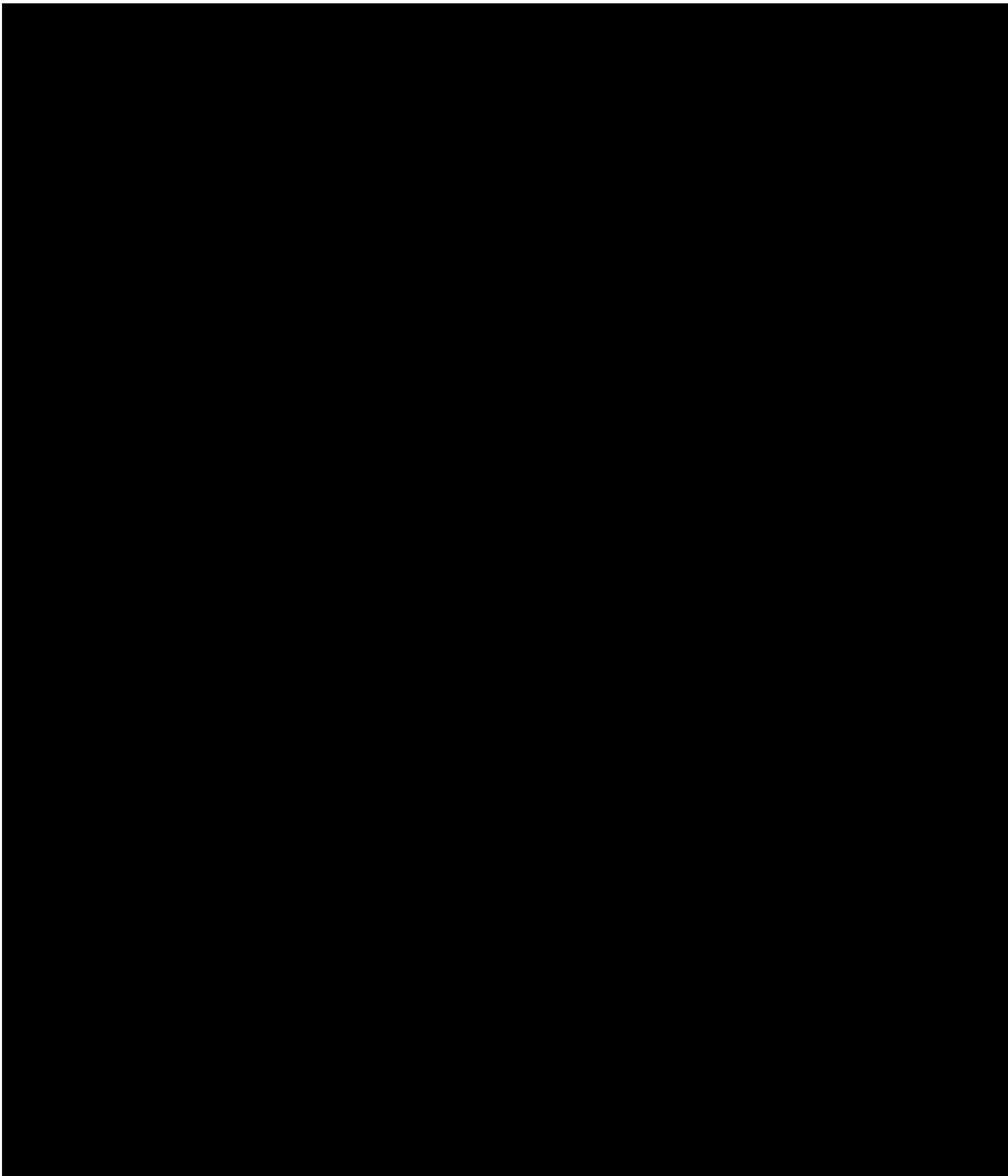


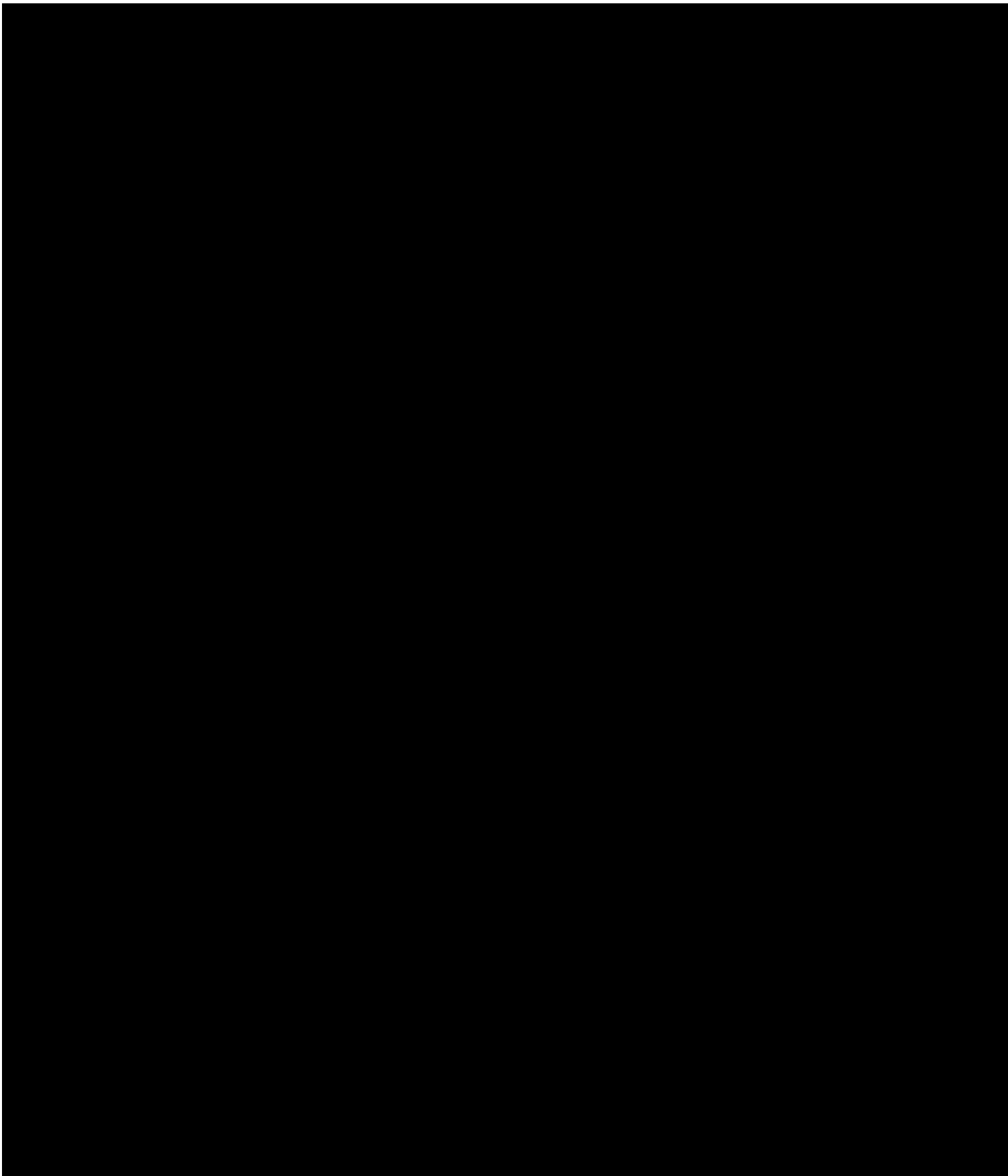


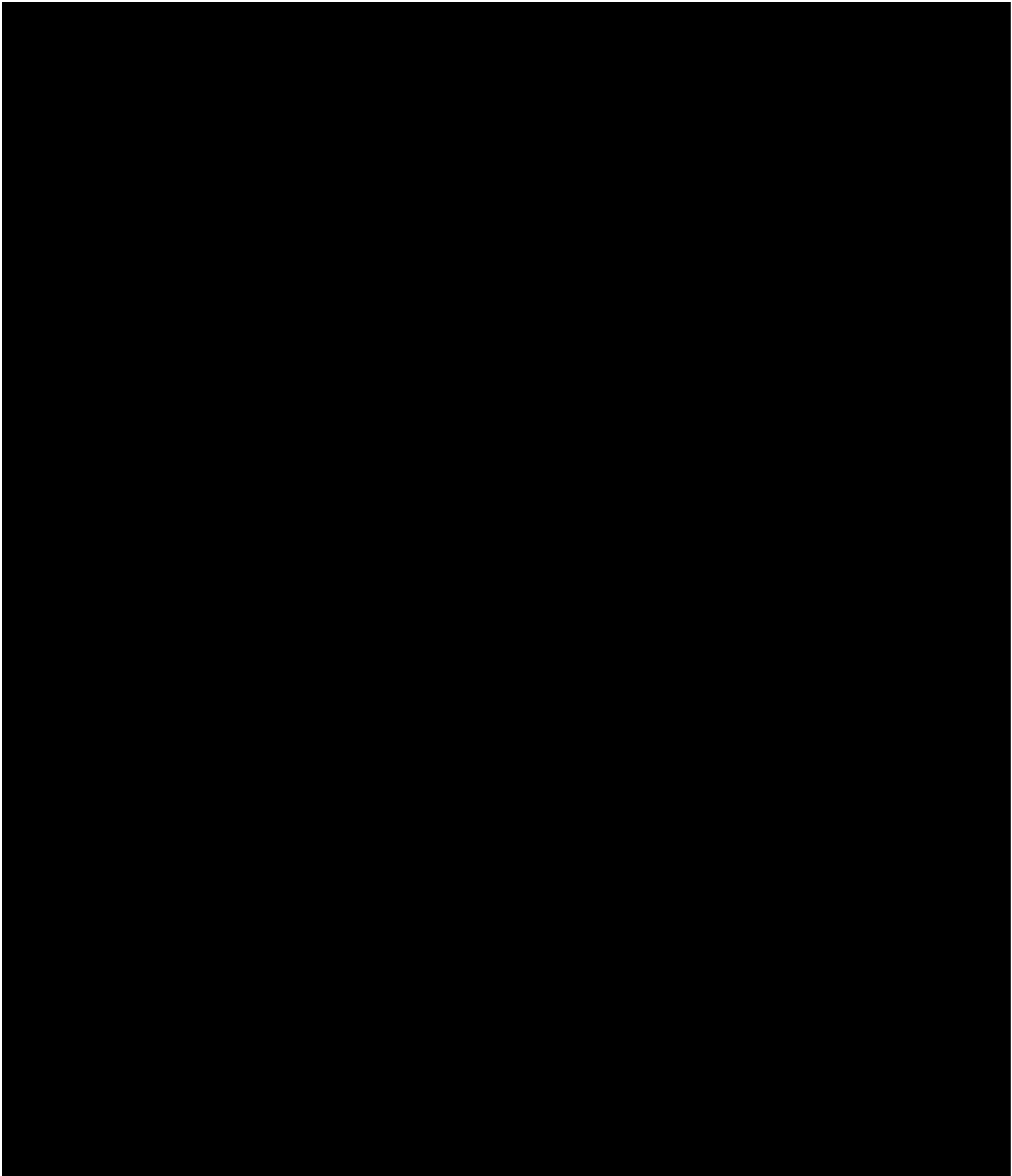


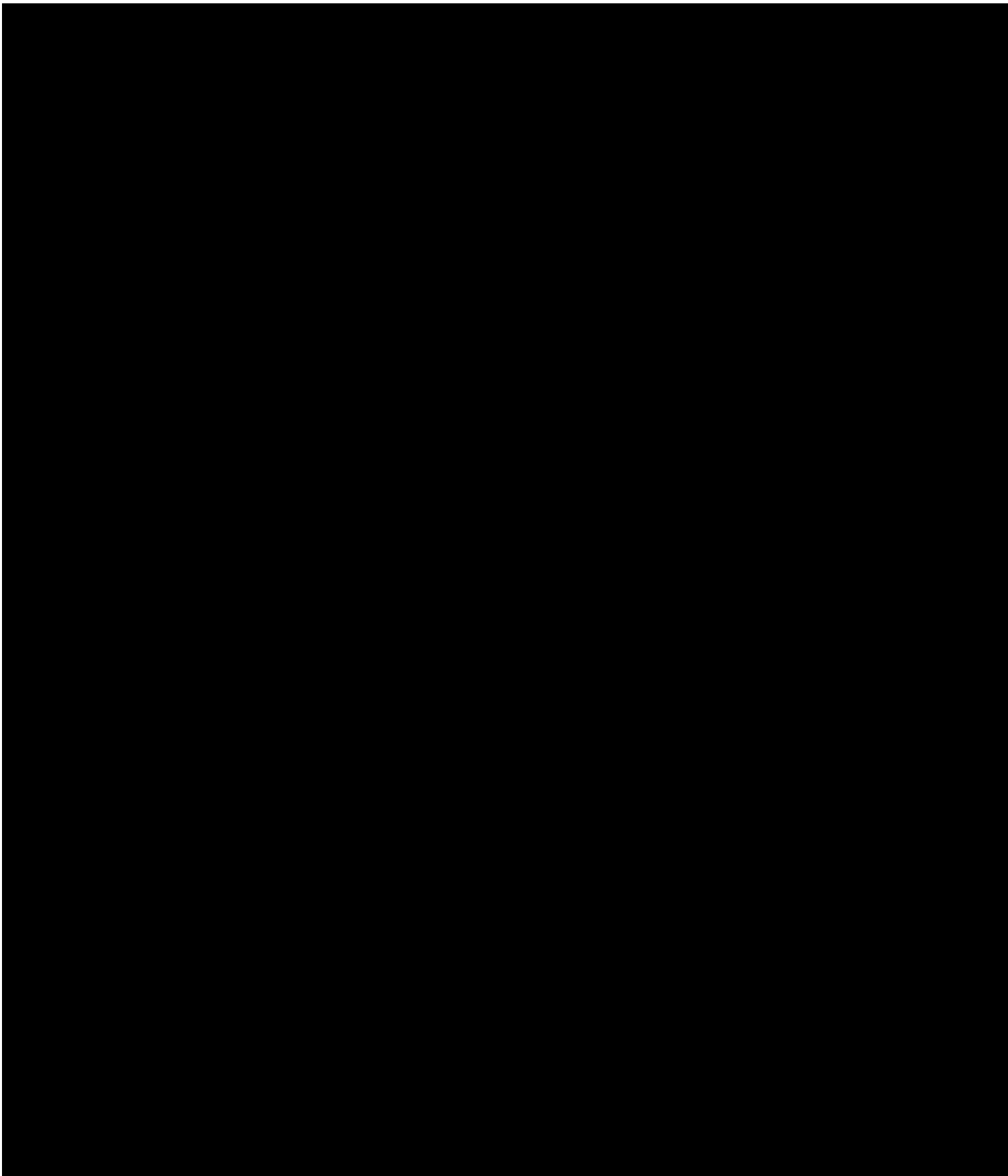


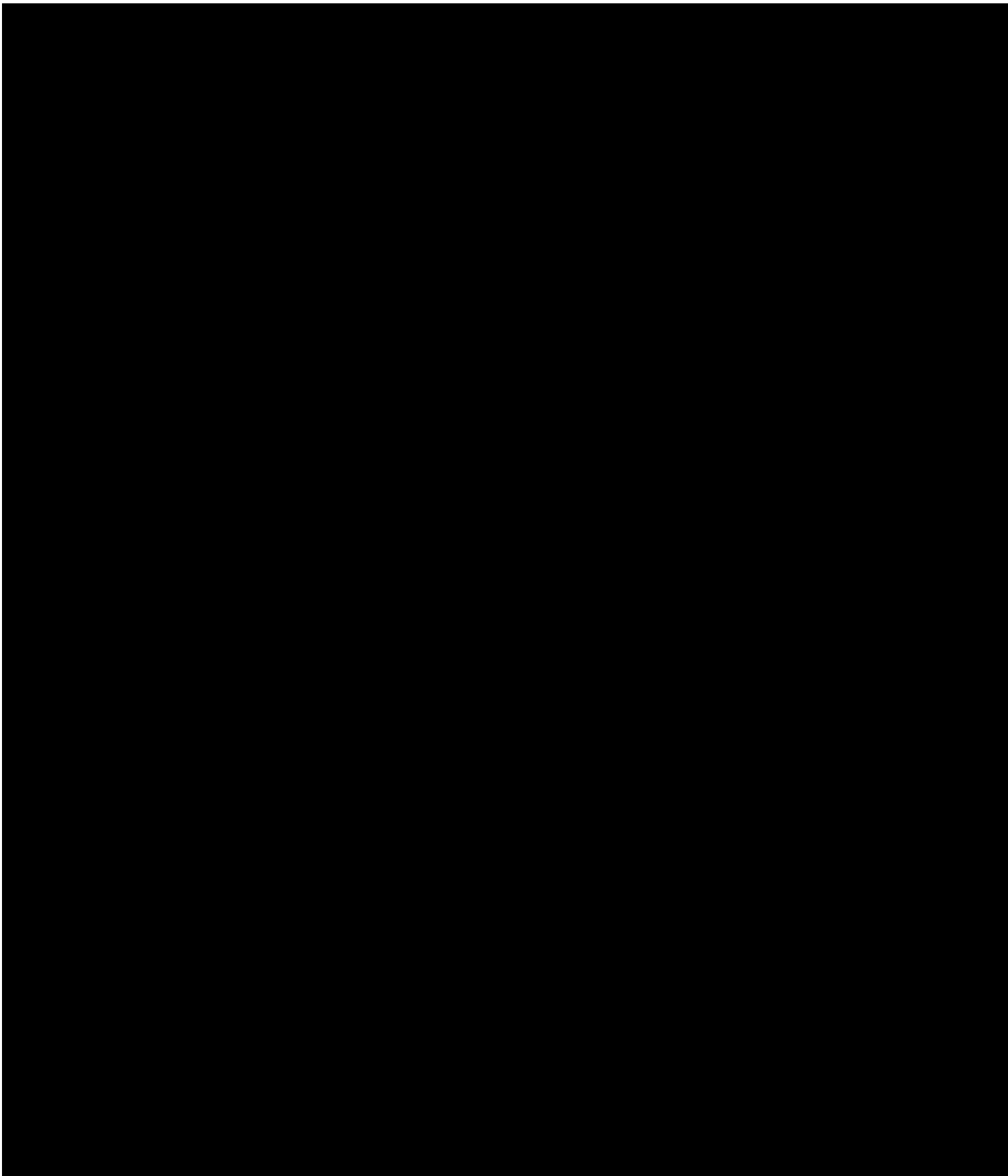


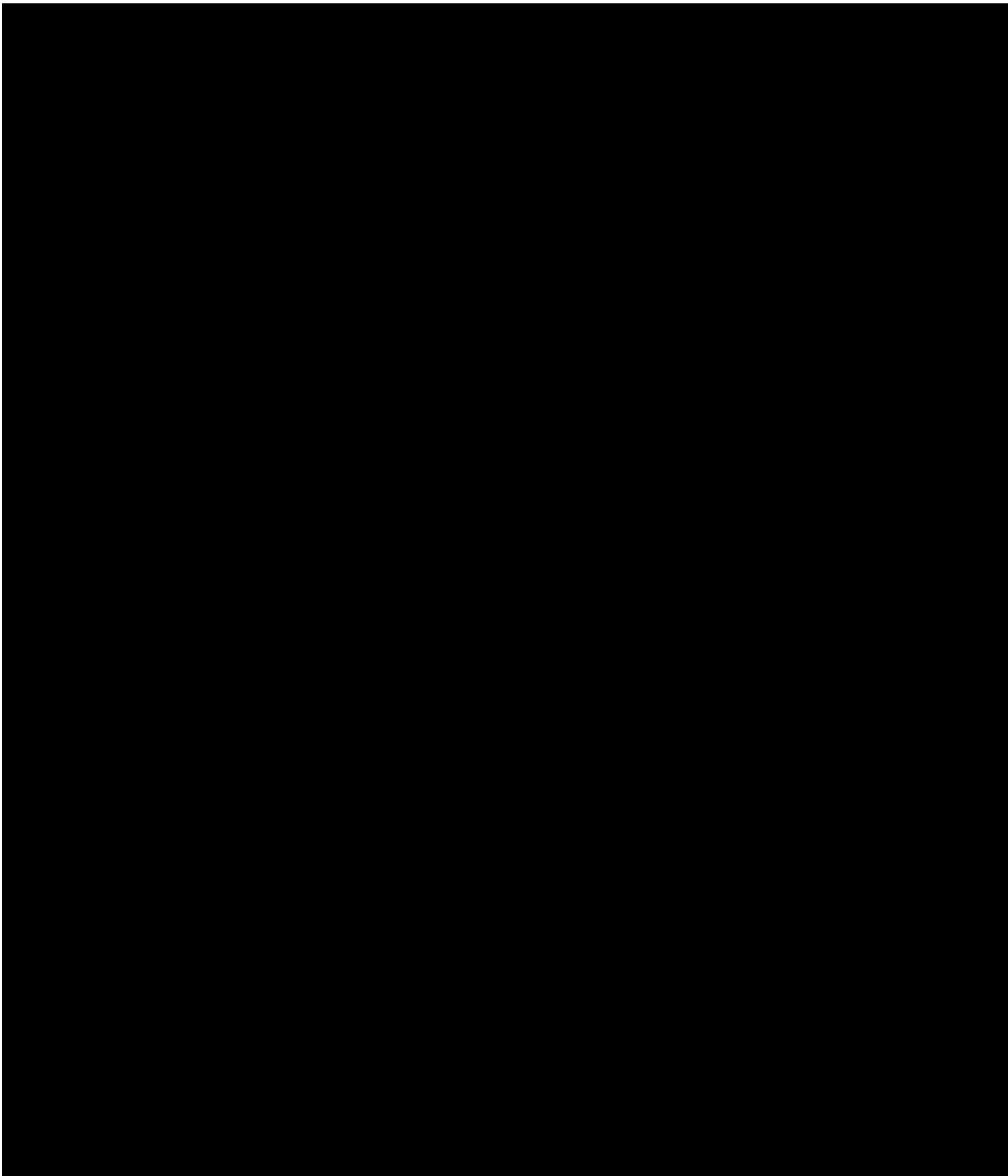


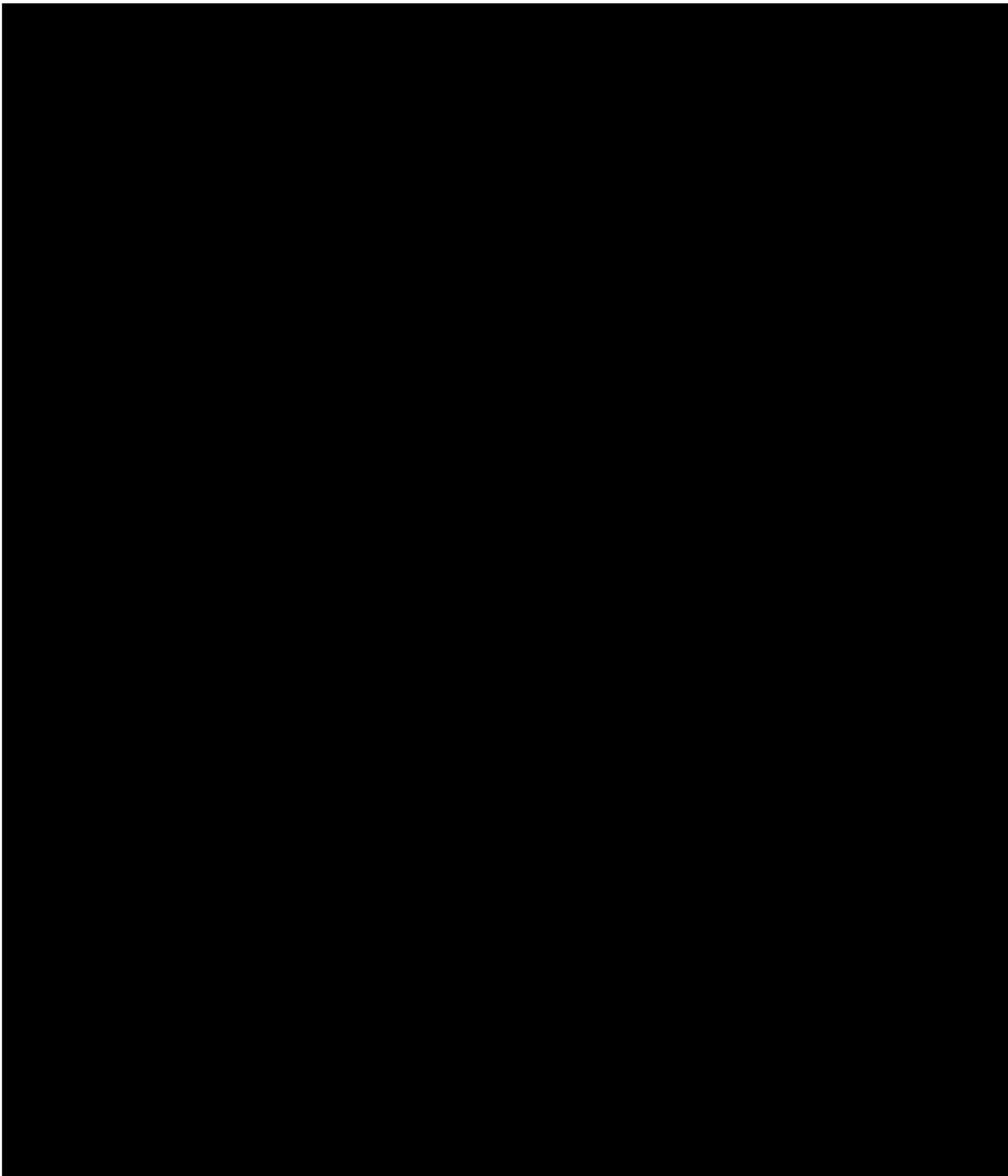


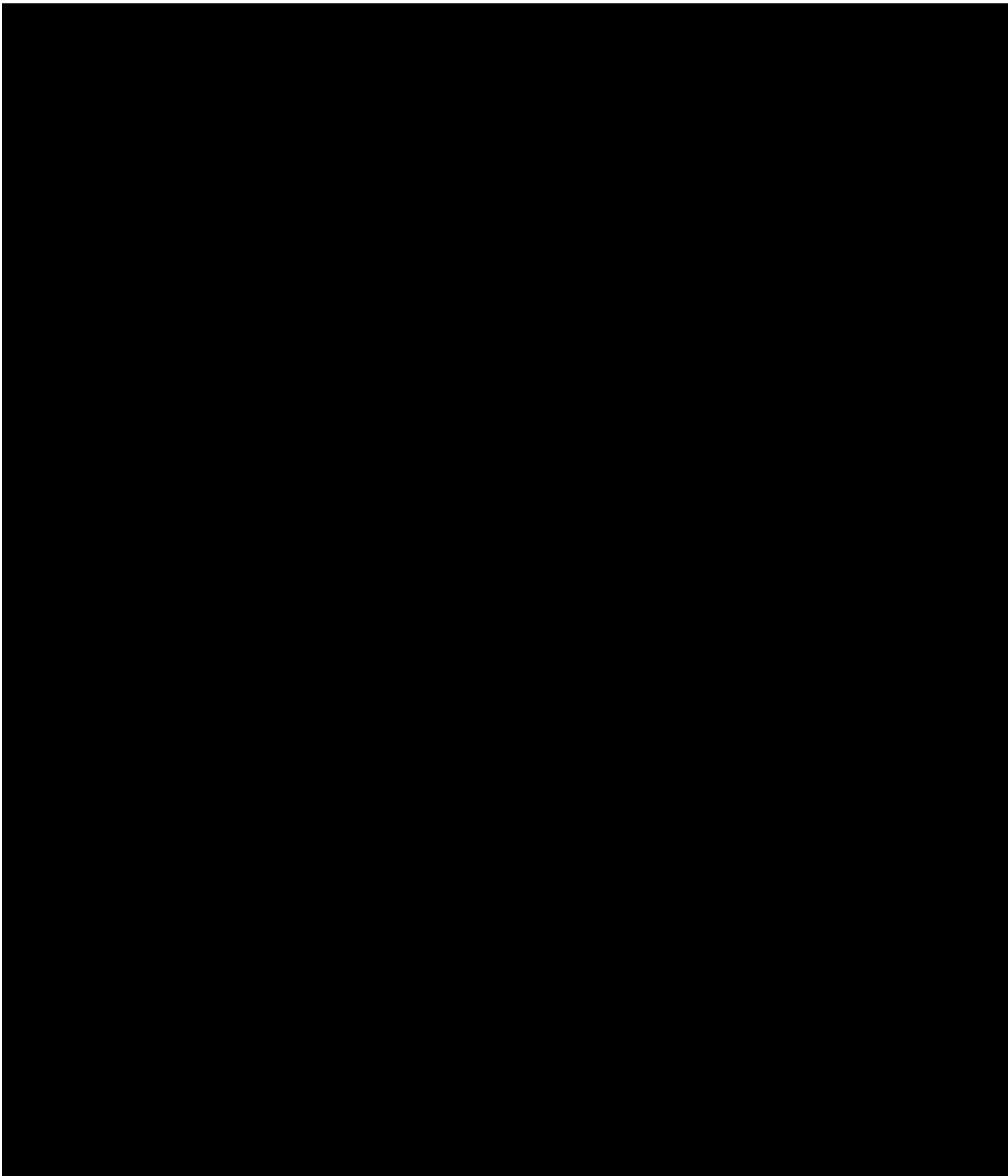


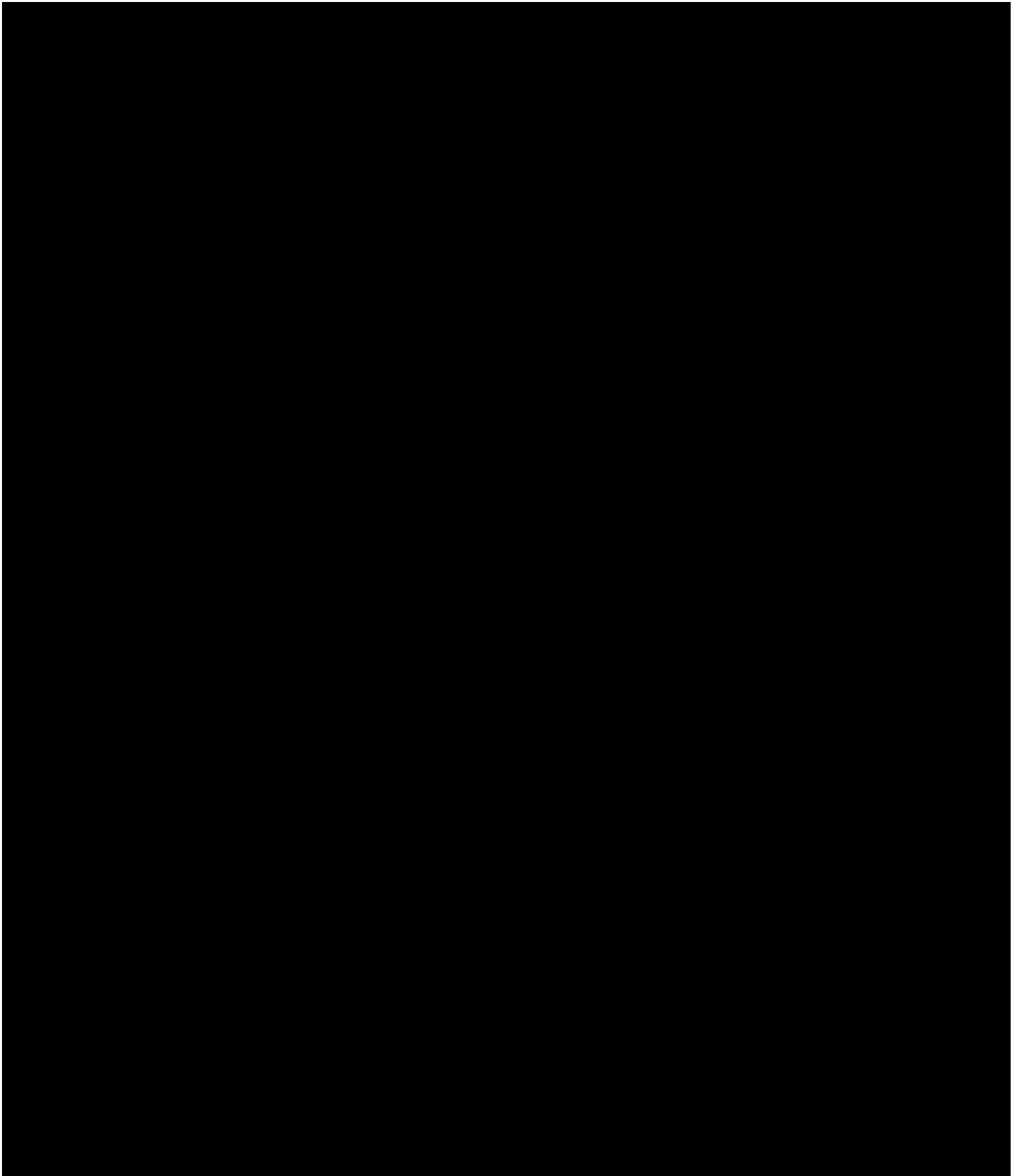


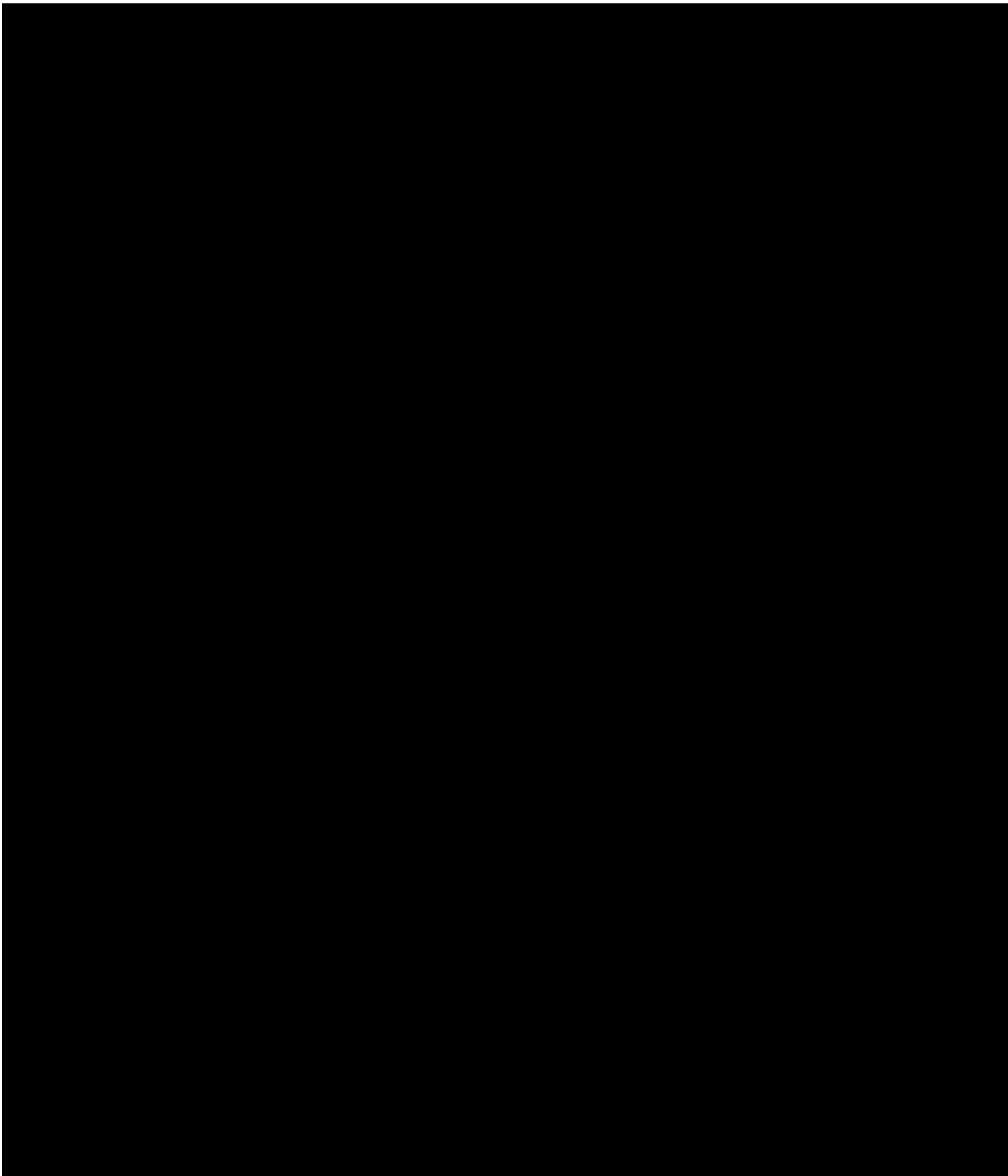


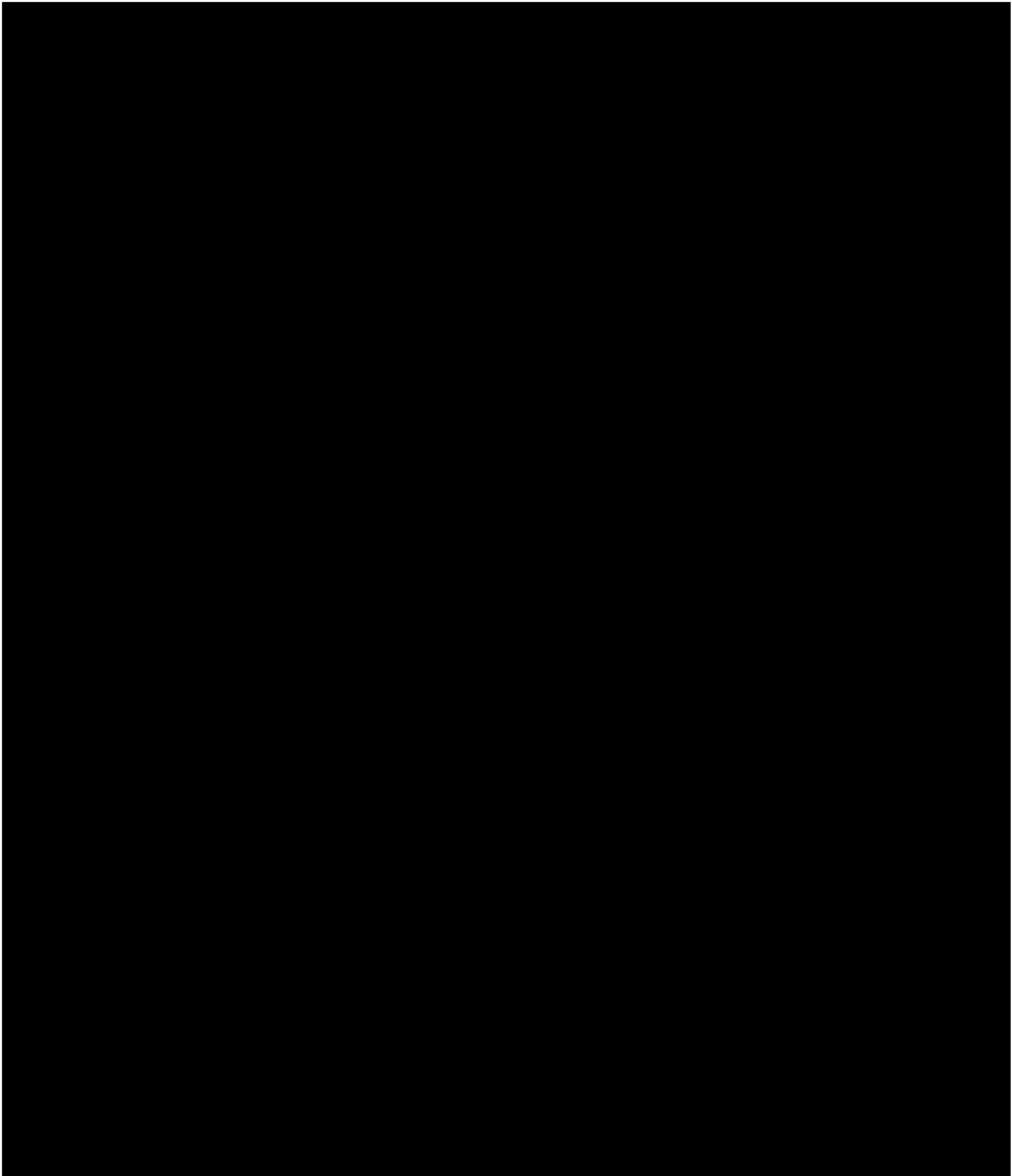


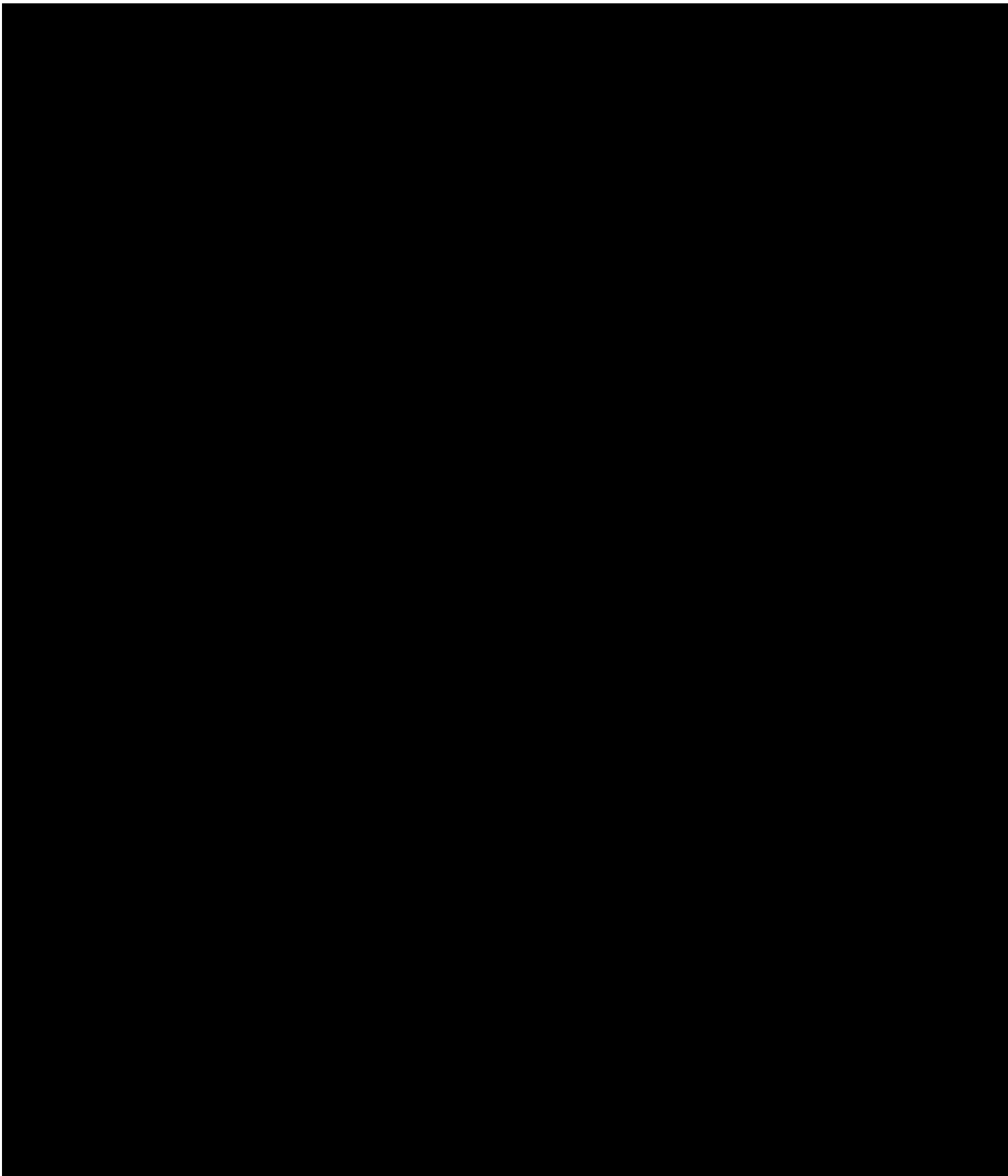


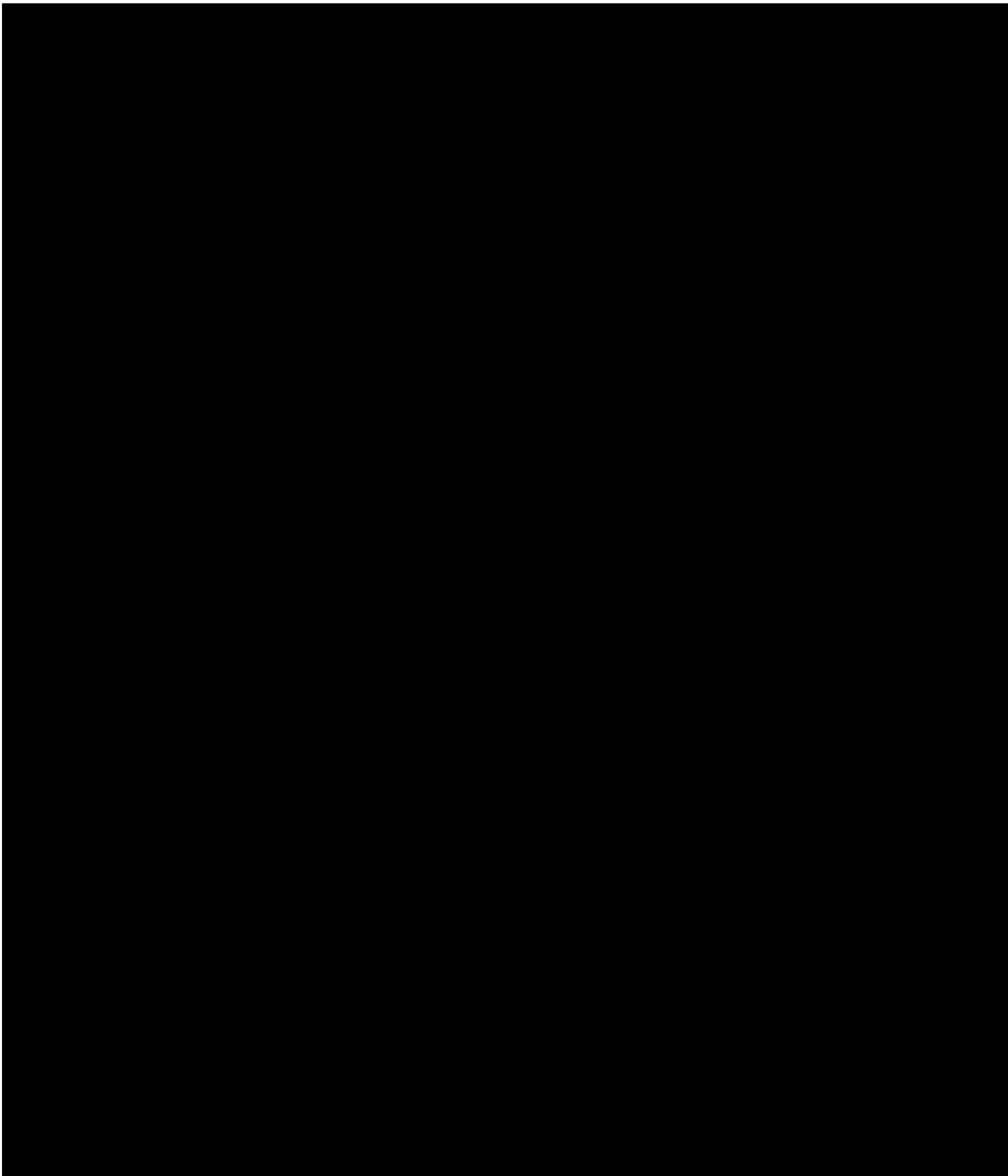


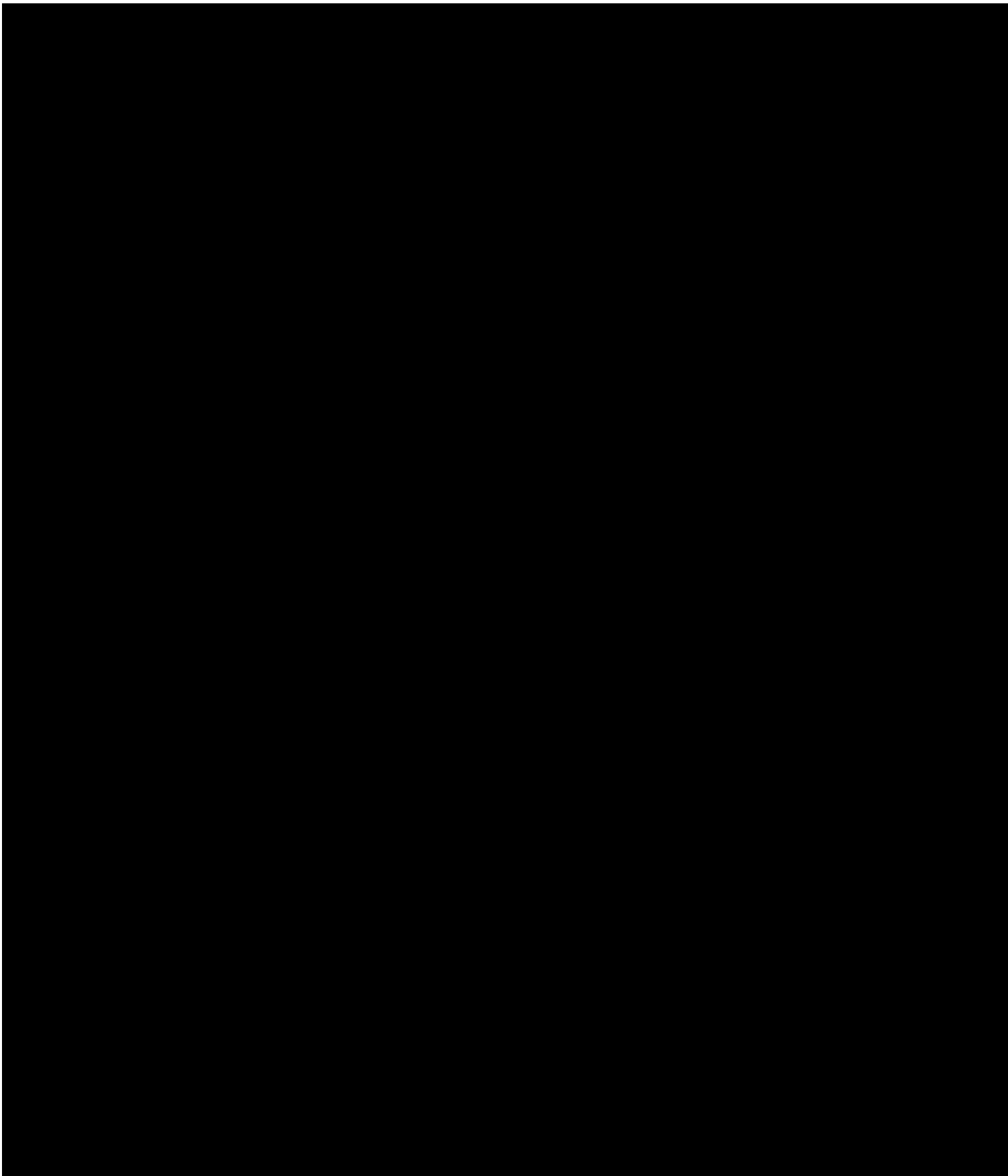


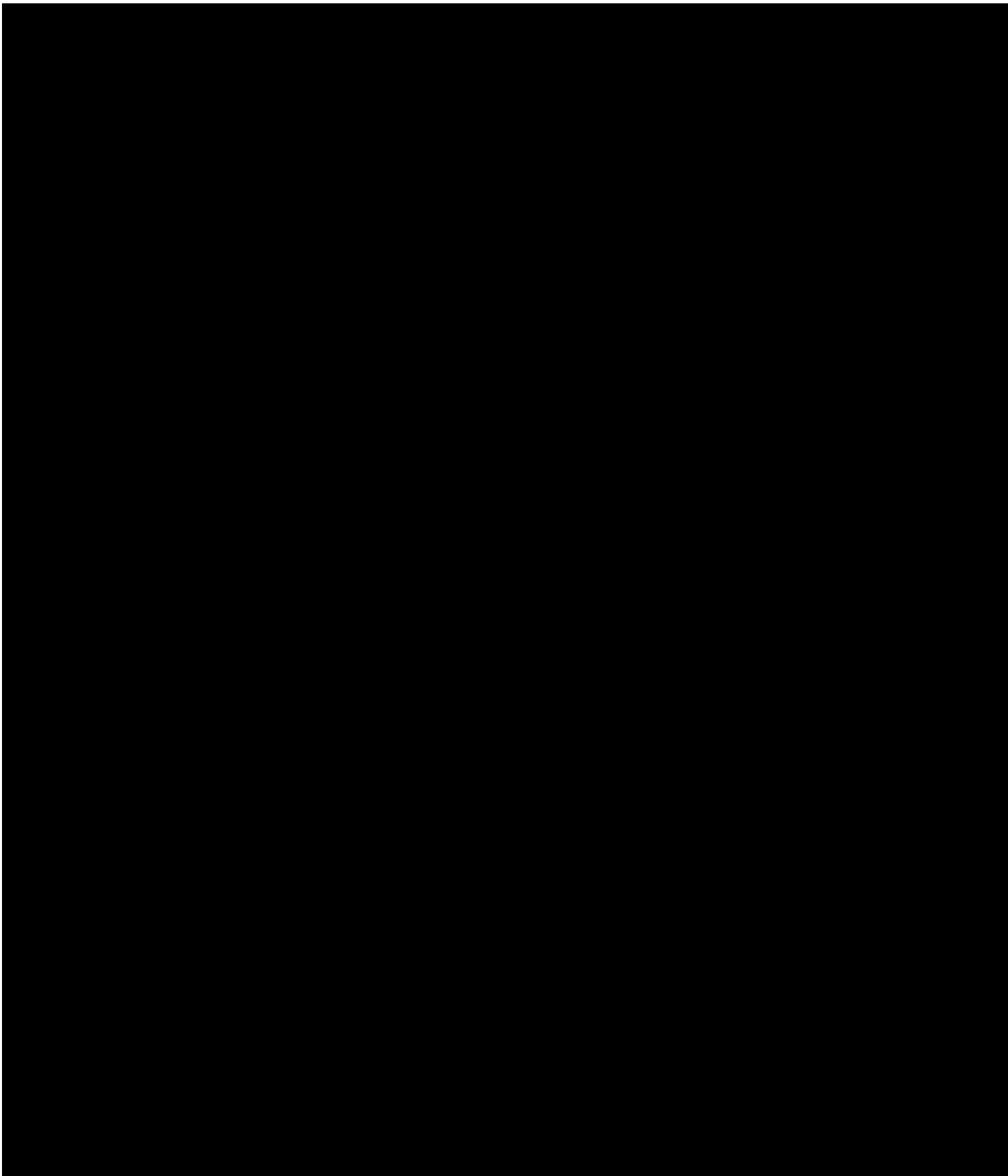


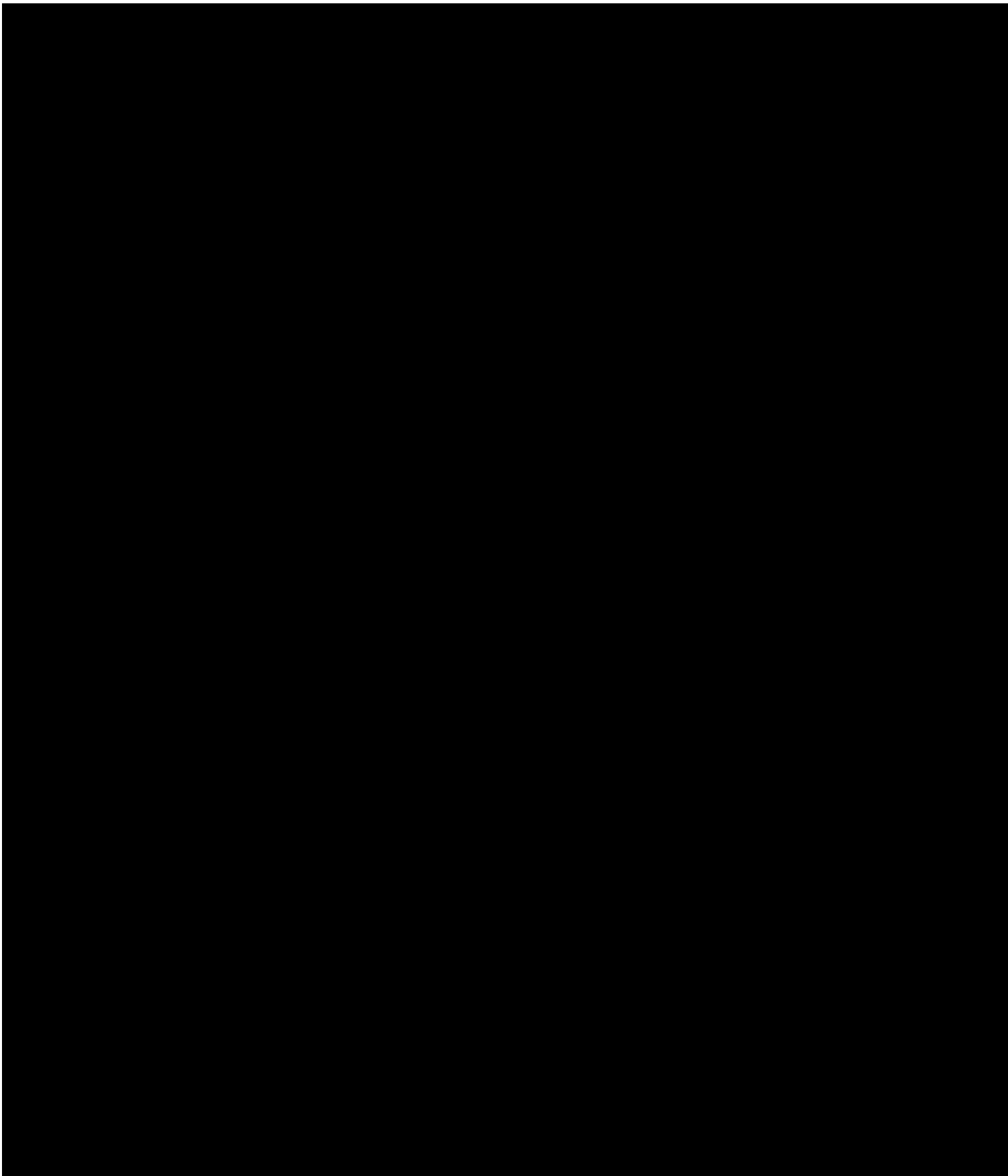


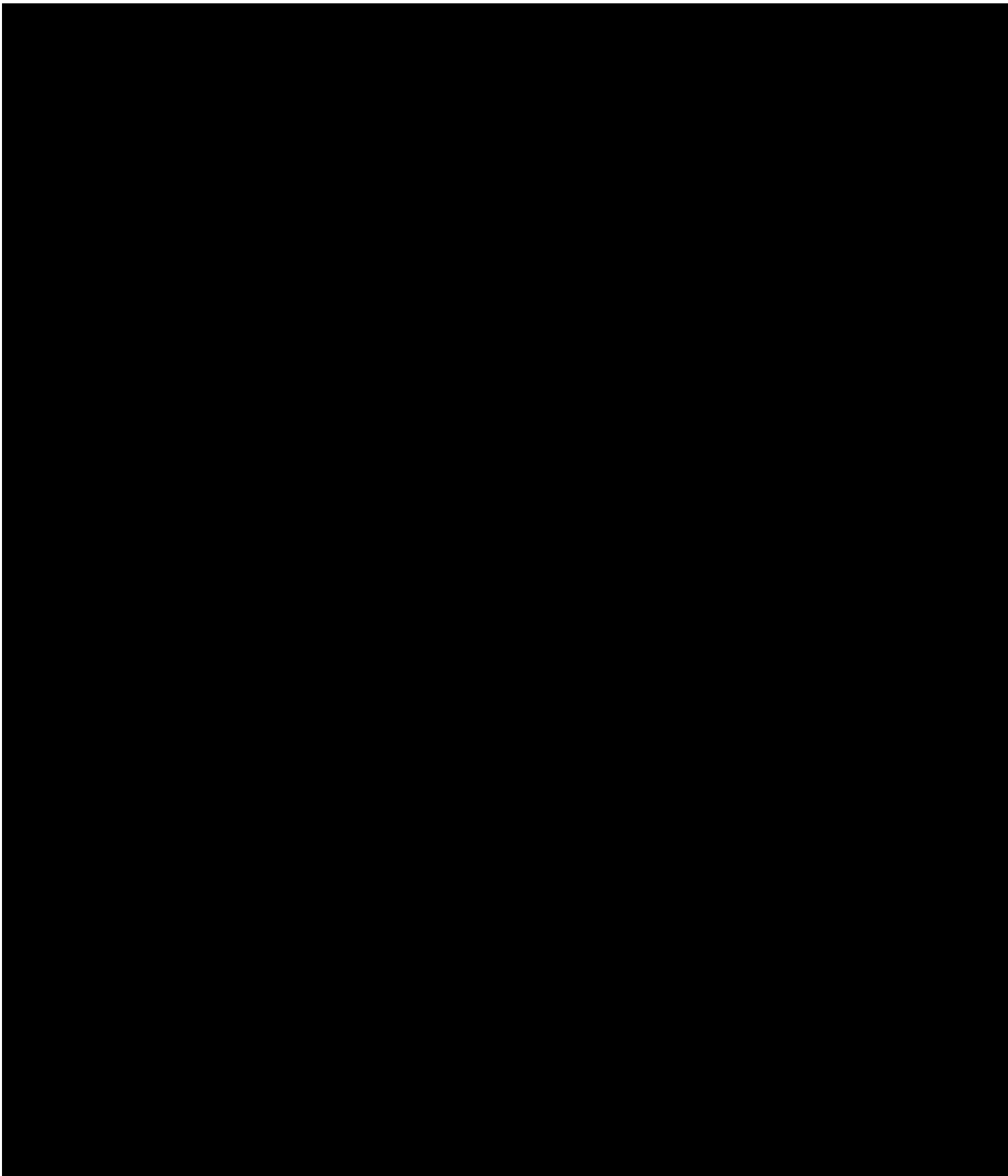


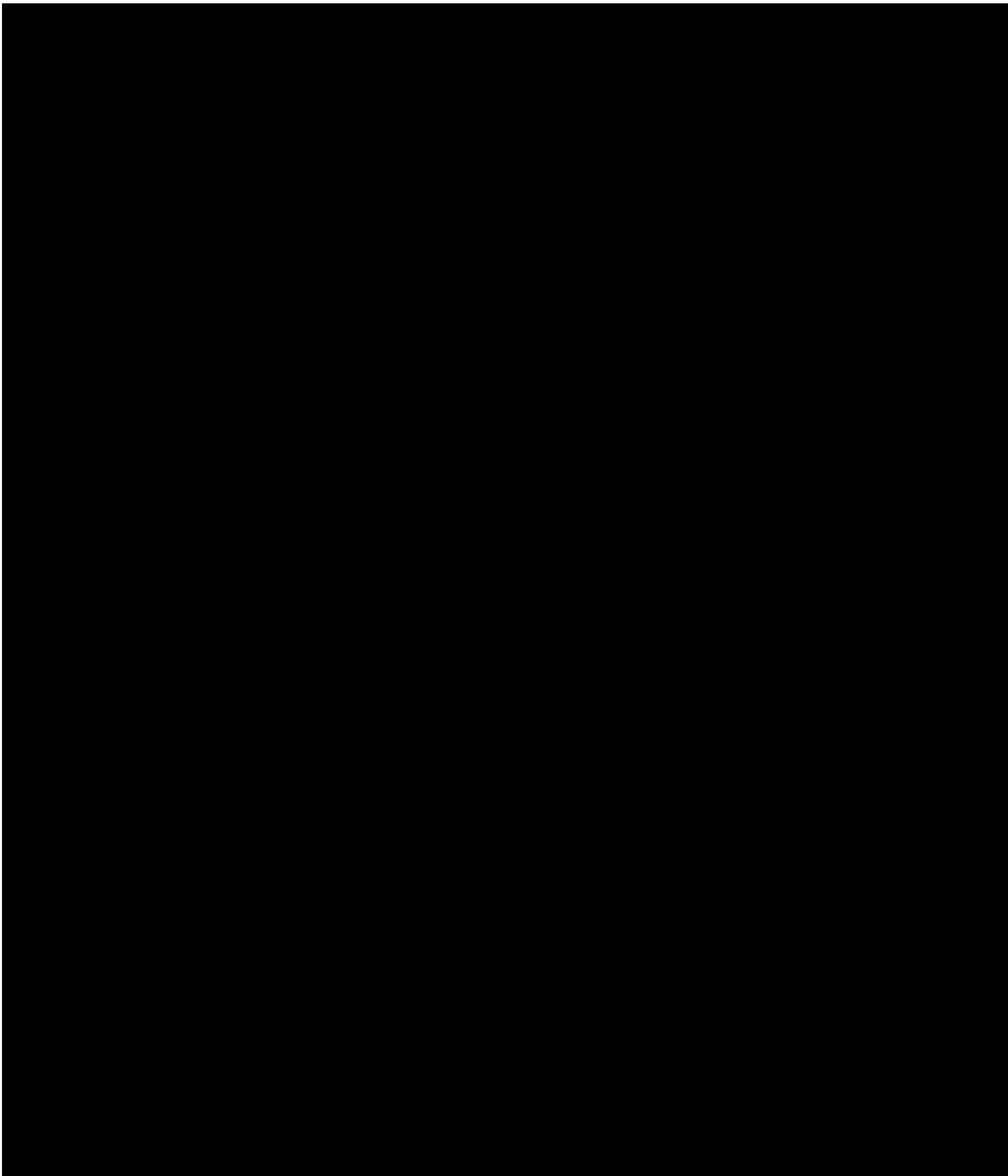


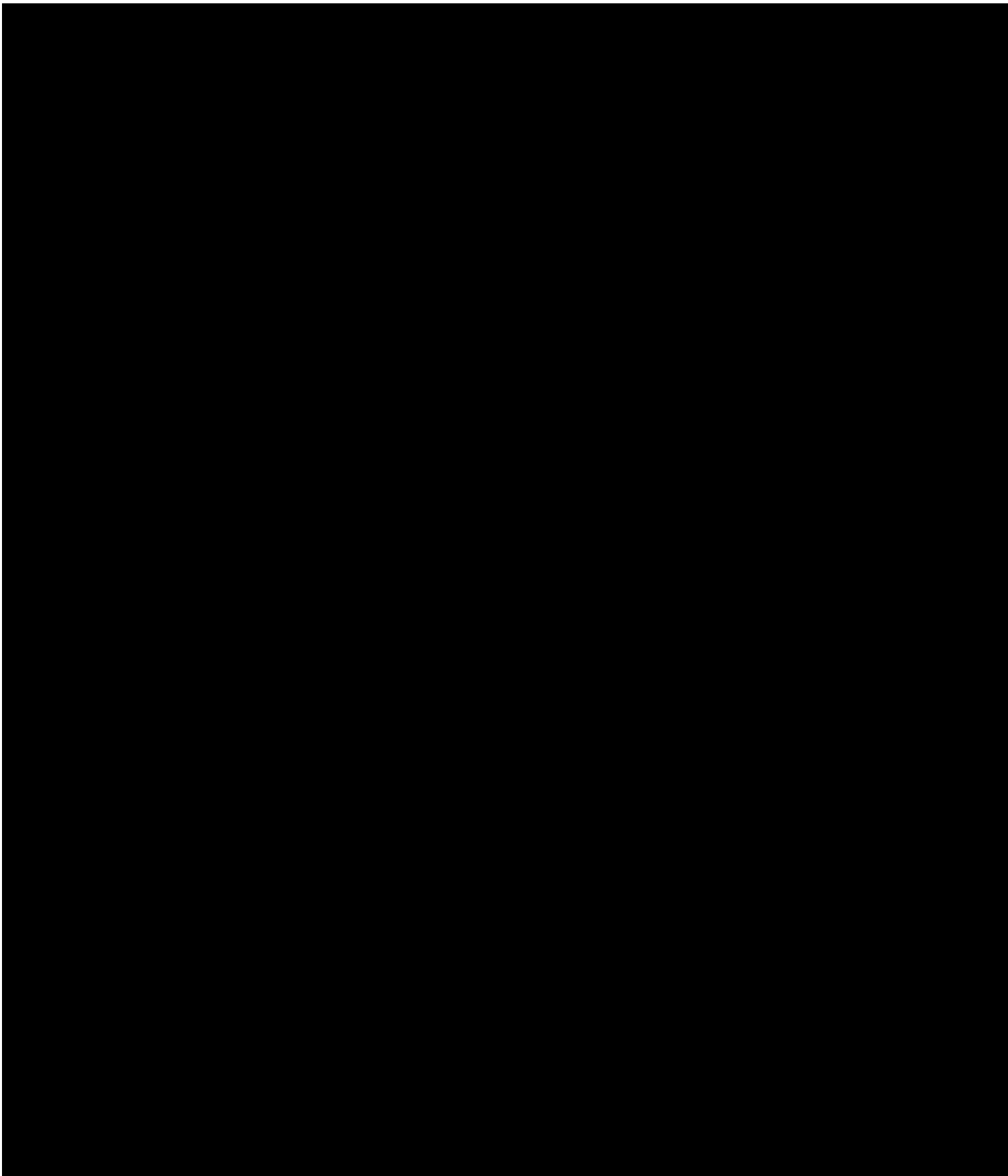


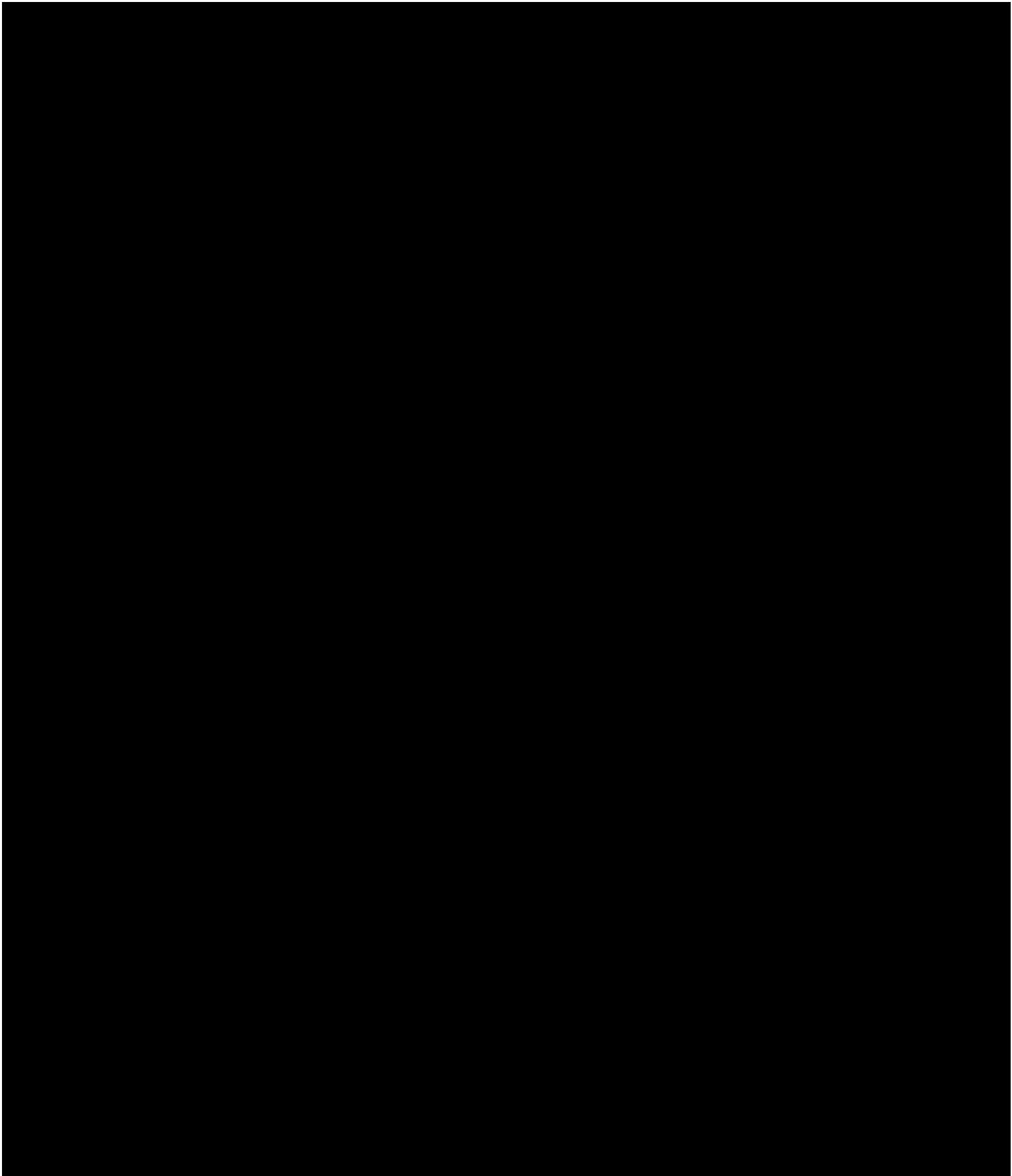


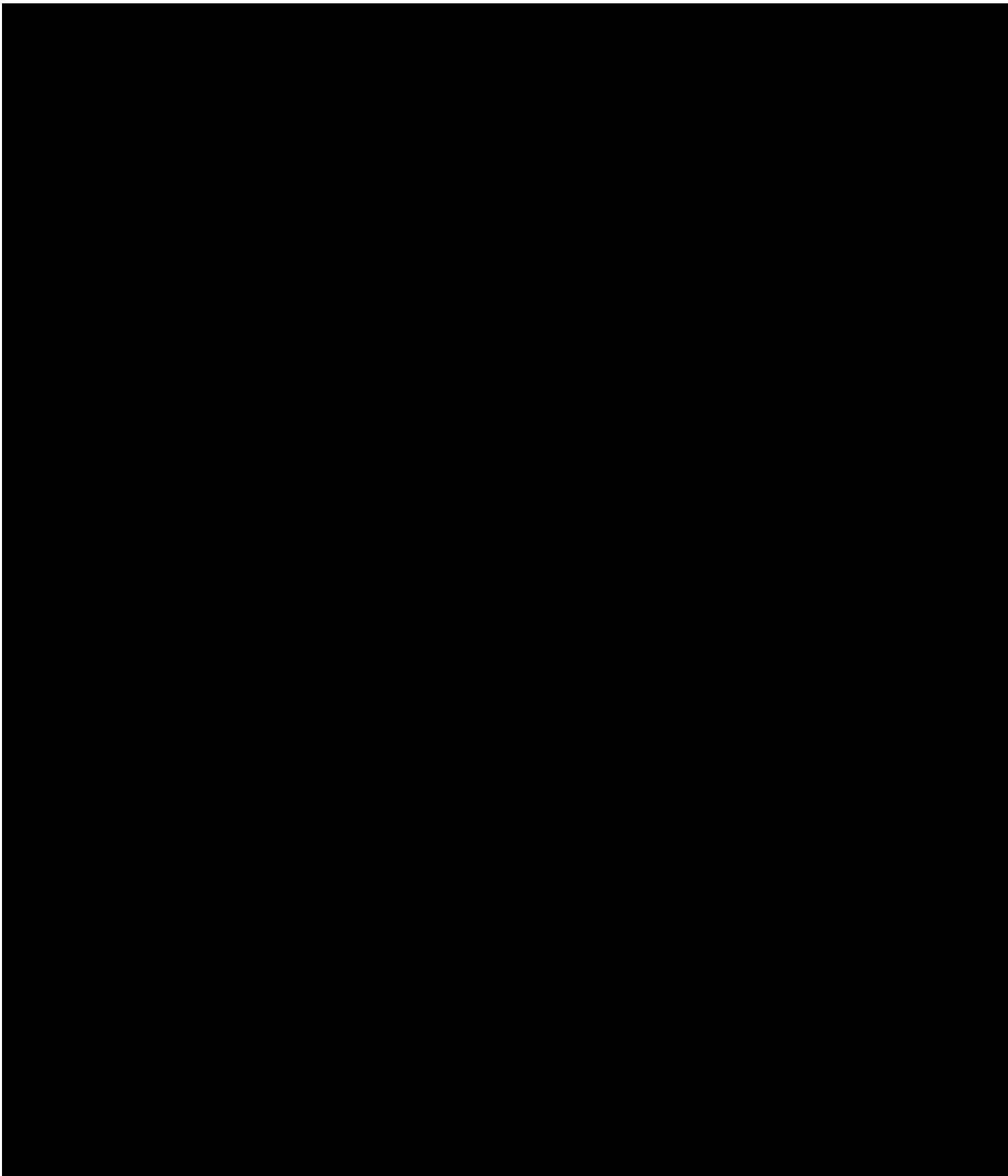


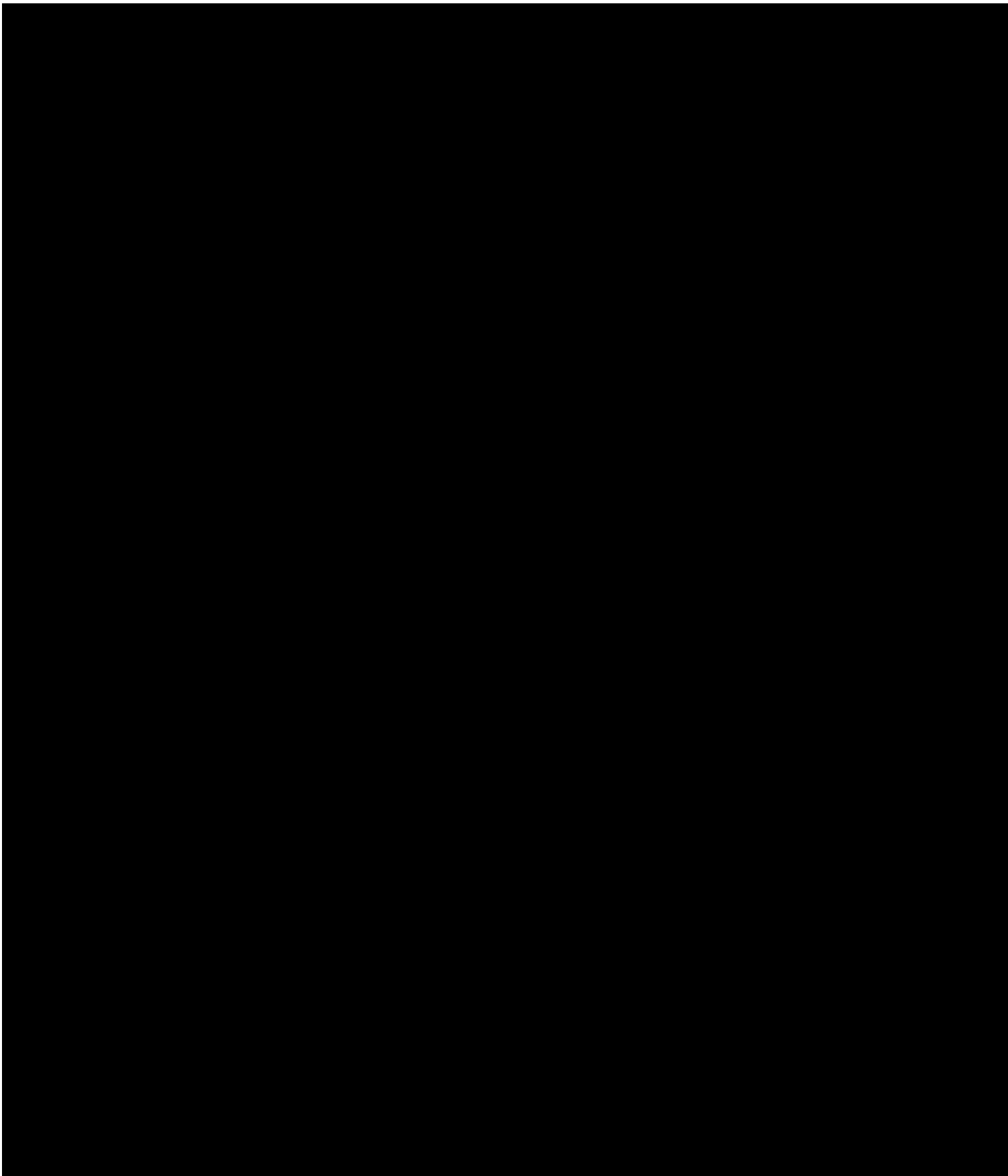












D. Prosecution history¹³

The '528 patent was filed as U.S. Application No. 14/172,392 (“392 Application”).

VII. CLAIM CONSTRUCTION

A. Sampling aperture

The parties agree that “sampling aperture” means “a period of time during which the switch is in its closed (i.e., on) state.” Ex.-2007.

B. Switch

The PTAB previously construed “switch” to mean “an electronic device for opening and closing a circuit.” *Intel Corp. v. ParkerVision, Inc.*, IPR2021-00346, Paper 33, at 25-26 (PTAB July 20, 2022), *aff'd*, *ParkerVision, Inc. v. Vidal*, No. 2022-2173, slip op. at 2 (Fed. Cir. 2024).

C. Energy storage element¹⁴

The PTAB construed “storage element” related to ParkerVision’s ’444 patent to mean “an element of a system that stores non-negligible amounts of energy from an input EM signal.” *Intel Corp. v. ParkerVision, Inc.*, IPR2020-01265, Paper 44, at

¹³ Ex.-2024, ¶¶173-177.

¹⁴ See Ex.-2024, ¶¶181-196.

44 (PTAB Jan. 21, 2022), *aff'd*, *ParkerVision, Inc. v. Vidal*, No. 2022-1548, slip op. at 14 (Fed. Cir. 2023).

The '528 patent claims, however, recite “*energy storage element*.” A POSITA reading the patents understands that an “energy” storage element is an element used in an energy transfer system.

Unlike the '444 patent claims, the '528 patent claims recite transferring energy and other claim language that are specific (directed) to an energy transfer system.

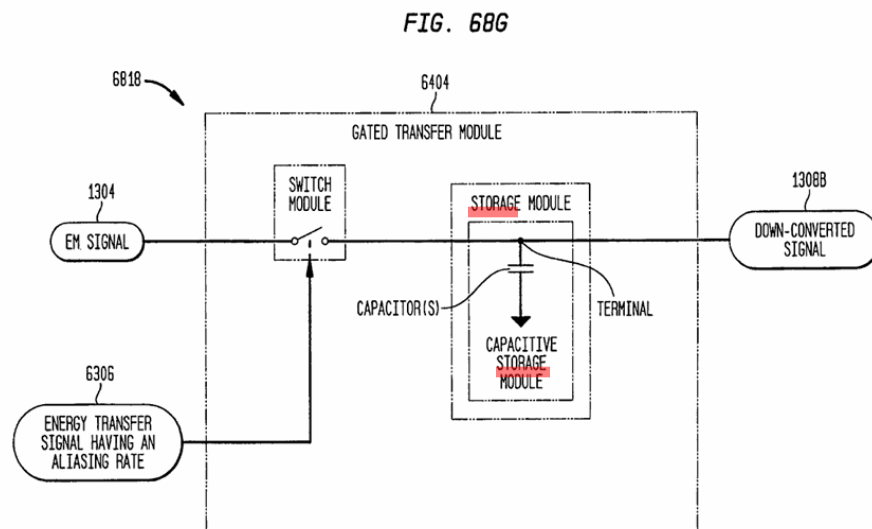
Claims 1 and 19 recite: “a portion of energy *that is distinguishable from noise* is transferred from the modulated carrier signal,” “energy storage element that *stores the transferred energy*...,” “the portions of transferred energy ... are integrated over time to accumulate said portions of transferred energy from which [the down-converted signals portions] are derived.” *See also* claims 8-10, 17-18, 26-28, 35-36.

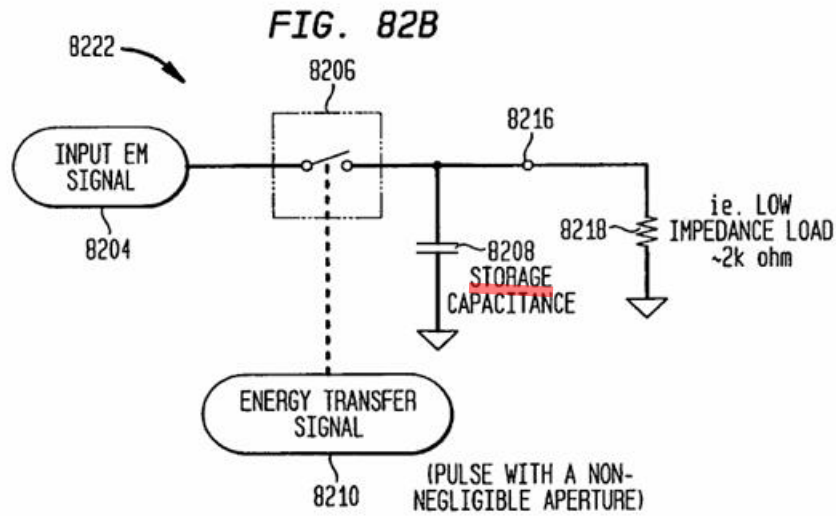
The construction of “storage element” already includes “non-negligible amounts of energy.” Thus, a POSITA would understand that an “*energy storage element*” must be something more than just an element that stores energy. Otherwise, the term “energy” in “*energy storage element*” would be meaningless.

An “*energy storage element*” is a use to denote a component of an energy transfer system. A “holding” element refers to a component of a voltage sampling system. Section VI.B.

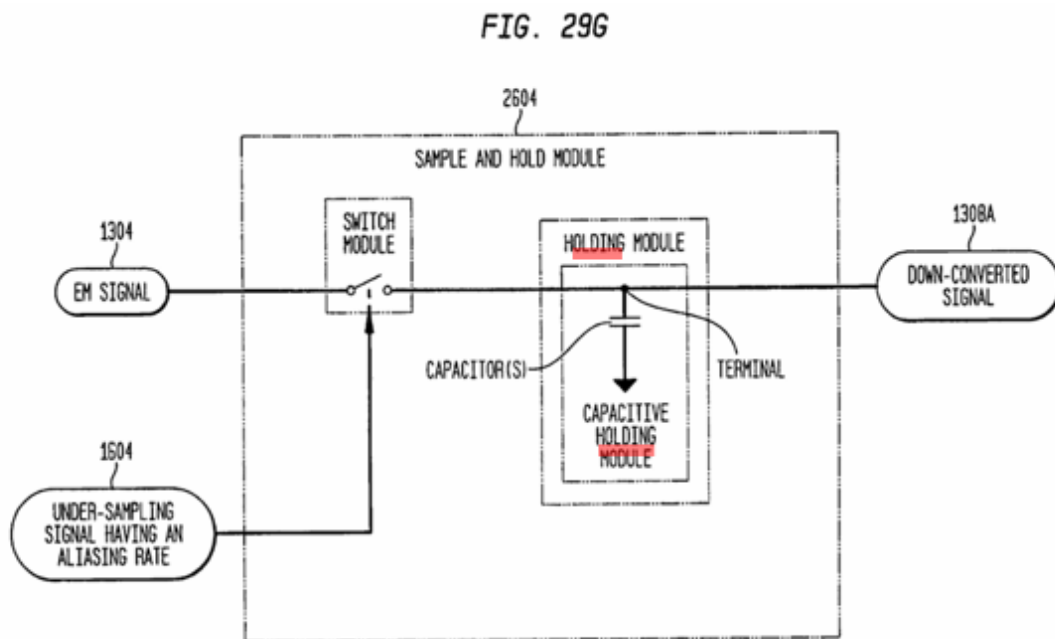
The Federal Circuit recently held: “ParkerVision’s down-converting system uses a technique called ‘energy sampling,’ which differs from the technique of ‘voltage sampling,’ which was used in conventional down-converting systems.” *ParkerVision v. Qualcomm*, 116 F.4th 1345, 1349 (Fed. Cir. 2024).

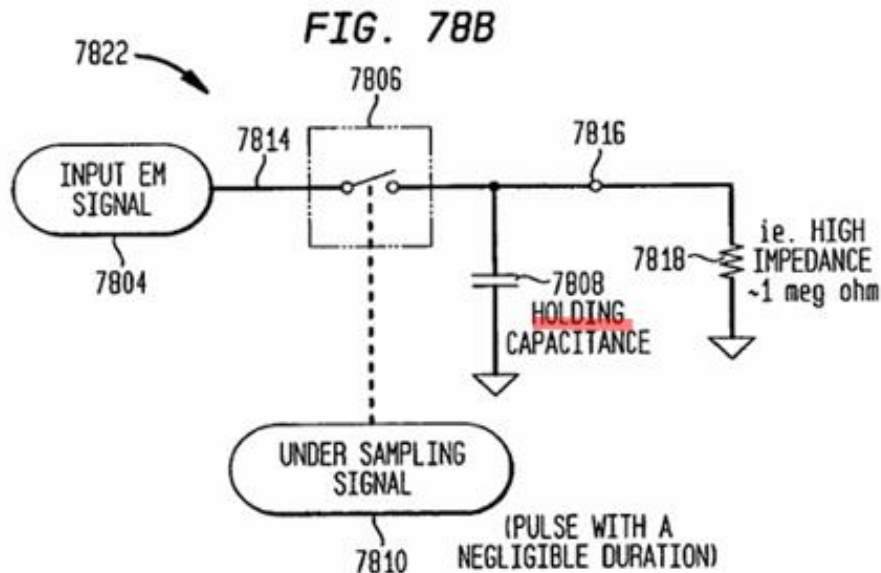
As discussed in Section VI.B.1 above and as shown in the figures below, an “energy storage element” is a term reserved for an element of an energy transfer system.





Figures 68G and 82B (above) show energy transfer systems and use the term “storage” module.





Figures 29G and 78B (above) show sample-and-hold systems and use the term “holding” module. Section VI.B.2.

For the foregoing reasons, the term “energy storage element” should be construed as “an element of an energy transfer system that stores non-negligible amounts of energy from an input EM signal.”

VIII. THE ALLEGED PRIOR ART

A. U.S. Patent No. 6,230,000

Taylor discloses a voltage sampling system for direct down-converting an input signal. Because Taylor is a voltage sampling system, Taylor does not transfer energy to a load. Ex.-2024, ¶¶196-199.

All discussion in Taylor refers only to voltage. See *e.g.*, Ex.-1004, Abstract; 2:28-42; 3:40-56; 4:2-4, 46-57; 5:37 46; Ex.-2024, ¶¶200-201.

Taylor discusses a solution to problems with prior direct down-conversion.

Ex.-1004, Figures 1, 2; 1:10-45; Ex.-2024, ¶202.

Specifically, Taylor discloses a product detector (part of a down-converter) for converting an RF signal to a baseband signal using a switch, which samples an RF signal (waveform) during periods of the RF signal. *Id.*, Abstract. Ex.-2024, ¶203.

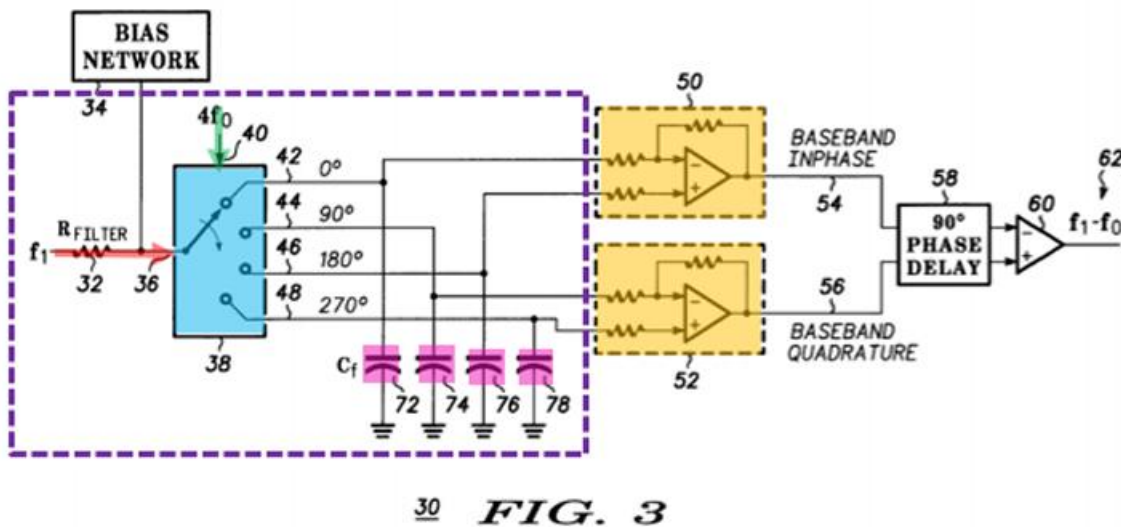


Figure 3 discloses a receiver 30 having a commutating switch 38 (blue), capacitors 72/74/76/78 (pink), and summing amplifiers 50, 52 (orange). Ex.1004, 2:6-12. The Taylor “product detector” is shown in the purple dashed box. *Id.* at 3:1-4. Ex.-2024, ¶204.

A RF or IF signal f_1 (red arrow) is received at the resistor R_{FILTER} 32, which forms a filter when combined with the capacitors. *Id.*, 2:13-15. Taylor touts this filter as being an important feature. Ex.-1004, 2:13-15, 3:21-39. Ex.-2024, ¶205.

The input signal f_1 is subsequently received by the switch 38 (blue). Ex.-1004, 2:16-17. 9. The switch 38 has one input 36 and four outputs 42/44/46/48. *Id.*, 2:17-18. Upon receiving a control signal (green) at input 40, the switch 38 can move to one of four different positions. *Id.*, 2:18-26. Ex.-2024, ¶206-207.

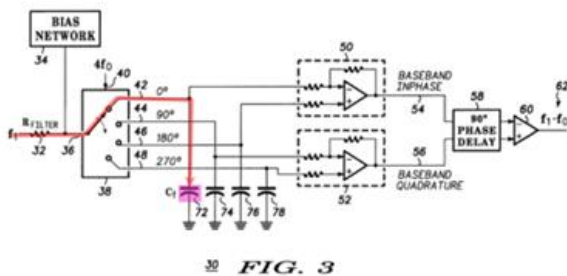


FIG. 3

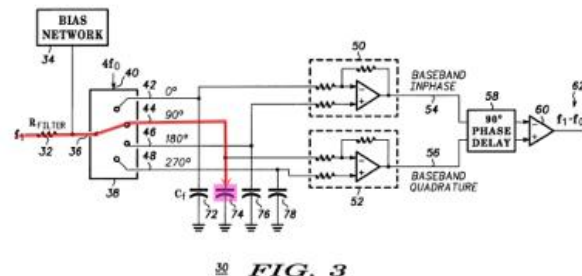


FIG. 3

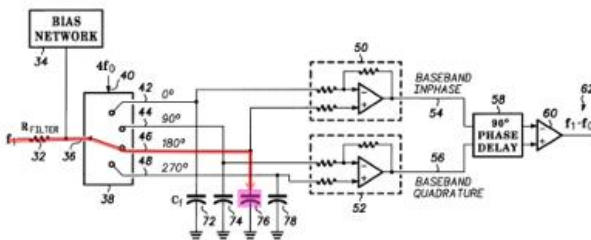


FIG. 3

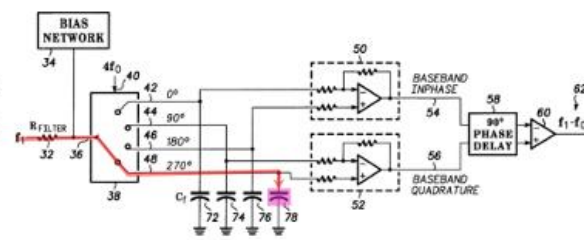
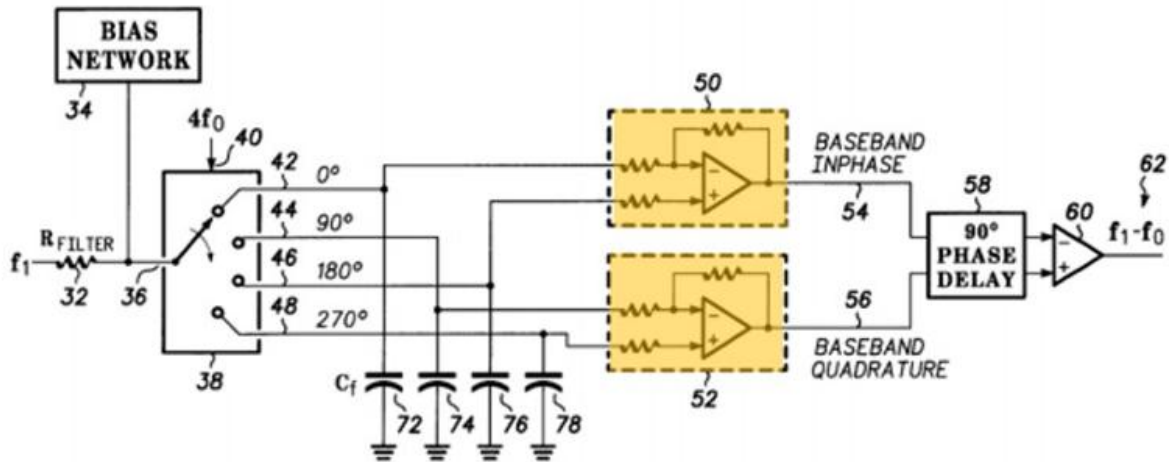


FIG. 3

“As commutating switch 38 cycles through the four outputs, capacitors 72-78 charge to voltage values substantially equal to the average value of the input signal during their respective quadrants.” Ex.-1004, 2:38-41; 2:32-38. Ex.-2024, ¶208.

According to Tayloe, each of the capacitors operate as a separate averaging component, which average a separate quarter wave of the input signal f_1 . Ex.-1004, 2:40-43. Ex.-2024, ¶209.

30 **FIG. 3**

As shown in Figure 3, “the outputs of commutating switch 38 are input to summing amplifiers 50 and 52” which produces baseband signals 54, 56. Ex.-1004, 2:56-61; Ex.-2024, ¶¶210-211.

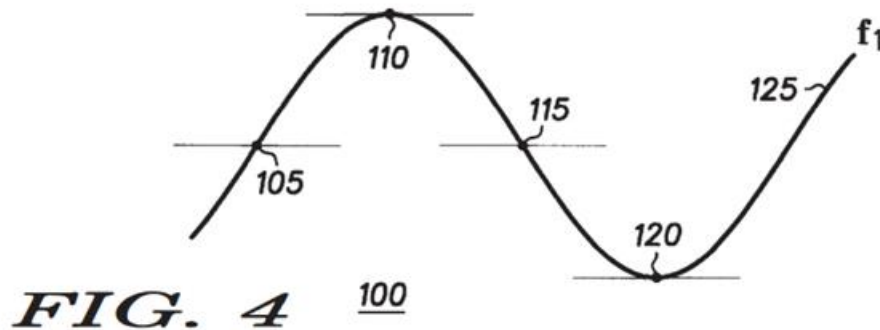
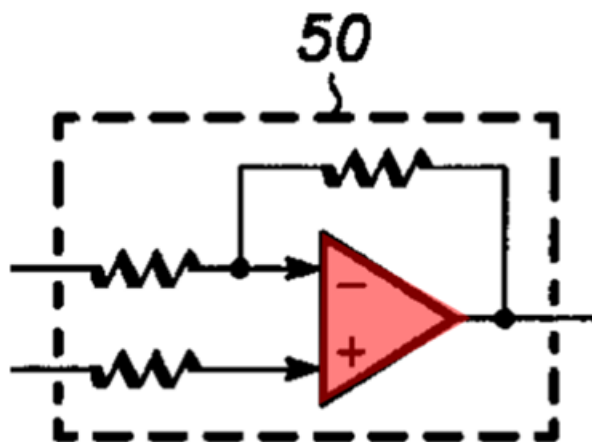


Figure 4 above illustrates how the system uses the input signal f_1 to determine the voltage to which each capacitor charges. Waveform 100 includes signal 125, which corresponds to the input signal f_1 . *Id.* at 3:40-42. Ex.-2024, ¶212.

The amplifiers 50, 52 are high impedance and capacitors are not discharging

to that load. Tayloe specifically states that the voltage on the capacitors charges to points 105/110/115/120. Ex.-1004, 3:40-48. In order for the voltage on the capacitors to charge to these points, there cannot be any discharge from the capacitors to a load. Otherwise, the voltage on the capacitors could not charge up to those points. Any charge in the capacitor (if discharged) would flow back to the RF input. *Id.*, 2:45-54; Ex.-2024, ¶213-215.

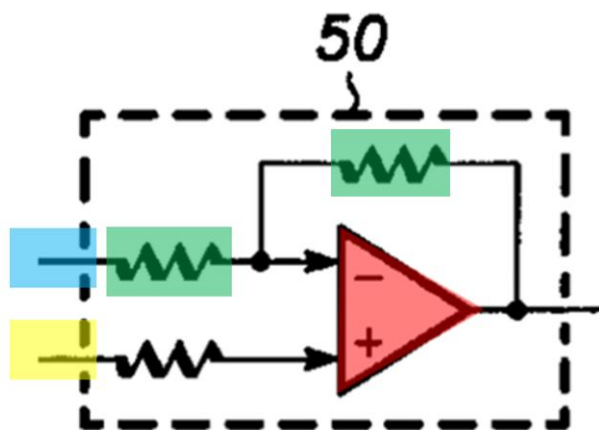


Tayloe discloses an op-amp (red triangle). Ex.-2024, ¶216.

A POSITA understands that the “+” and “-” inputs are connected to the gates of FETs. Ex.-2034, 72:9-73:6, 127:4-19. This results in very high impedance/high resistance. Dr. Galton admits this. *Id.*, 72:14-73:6, 85:1-7; Ex.-2024, ¶217.

A POSITA understands that if one input is high impedance/resistance, the other input must also be high impedance/resistance. As shown above, there is no feedback loop around the lower portion of amplifiers 50, 52. The input goes into the gate of a FET—very high impedance/resistance—, so “+” input will be high

impedance/resistance. Ex.-2034, 122:18-123:10, 126:7-127:1. And because the “+” input is high impedance/resistance—e.g., millions of ohms,¹⁵ the “-” input must also be high impedance/resistance. Ex.-2024, ¶218-219.



As shown above, the input resistance of the yellow and blue inputs must be matched. Because the yellow input is connected to the “+” input, which is very high impedance, the input resistance of the blue input must also be very high. Thus, resistors (green) must have very high resistance/high impedance. If the input impedances of blue/yellow do not match, voltage measurements will be asymmetric and introduce error. Ex.-2024, ¶220.

¹⁵ The most common op-amp at the time was the 741 Series op-amp, which had a high input resistance, typically 2,000,000 ohms. Ex.-2009; See Ex.-2004, 125:15-126:6.

The “+” and “−” inputs cannot be substantially mismatched. Ex.-2034, 82:17-86:5, 87:5-88:6, 92:22-93:16, 96:11-21, 97:20-100:21, 101:2-20. Ex.-2024, ¶221.

Dr. Galton asserts that at higher frequency, impedance is lower; and at low frequencies, impedance is higher. Ex.-2034, 116:21-118:9, 126:7-127:1. Tayloe specifically discloses using a frequency of 1kHz centered at 7MHz. Ex.-1004, 5:49-50. This is a low frequency. Thus, under Dr. Galton's own logic, that Tayloe uses a low frequency input further supports that the “+” input of the op amp is high impedance. Ex.-2024, ¶222.

Given the above, a POSITA would understand that both “+” and “−” inputs of Tayloe's op-amp present high impedance loads. Ex.-2024, ¶¶223-224.

As the charge is being held in Tayloe, the system determines the voltage across the capacitor. At the next sampling interval, the voltage on the capacitor will change to the next average voltage value. Using multiple voltage readings, the system recreates a baseband signal. Ex.-2024, ¶225.

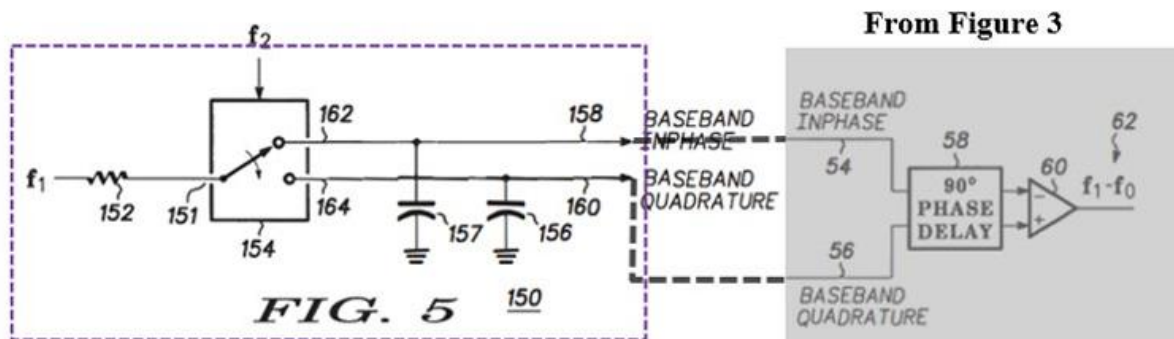


Figure 5 discloses another product detector 150 (purple dashed box). Ex.-1004, 4:9-15, 42-44. Figure 5 works the same as Figure 3 with regards to holding the average voltages on the capacitors and the analysis applies equally. Ex.-2024, ¶226.

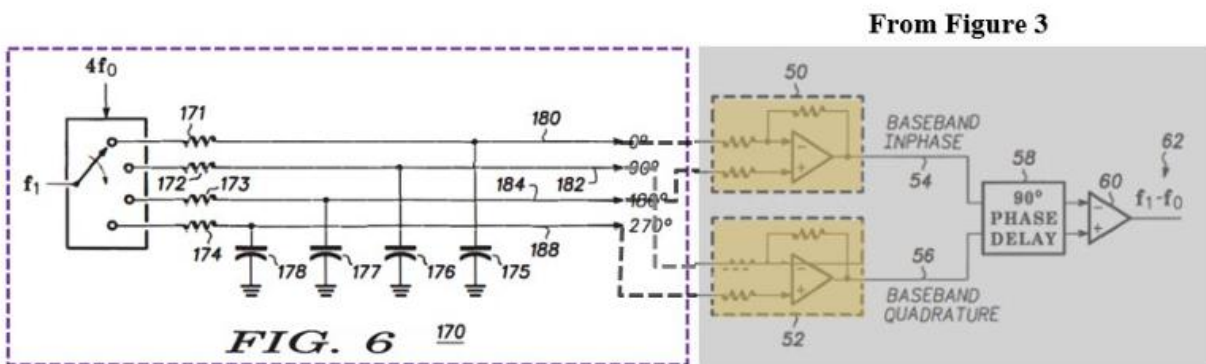


Figure 6 discloses another alternative embodiment of a product detector 170 (purple dashed box). Ex.-1004, 4:46-49. A POSITA would understand that Figure 6 would be connected to amplifiers 50, 52 just like the product detector of Figure 3. Ex.-2024, ¶227.

In Figure 6, with the R_{FILTER} removed and replaced with separate resistors after the switch 38, the radio frequency source is connected directly to the commutating switch 38. The circuit of Figure 6 works the same as Figure 3 with regard to holding the average voltages on the capacitors 175/176/177/178 and the analysis of Figure 3 above applies to Figure 6. Ex.-2024, ¶228.

Moreover, with regard to Figure 6, Tayloe clearly focuses only on voltage and how only voltage is controlled by the combination of the capacitor and resistor. Ex.-1004, 4:49-57. The statement that the voltage of the outputs are controlled by the capacitor and resistor means that the voltage across each capacitor is not affected by the circuitry to the right of the capacitor. This demonstrates that amplifiers 50/52 and/or other circuitry to the right of the capacitors 175/176/177/178 is a high impedance load to each capacitor, which is well known characteristic of any voltage sampling system. In view of the foregoing, Figure 6 of Tayloe is operating as a voltage sampling system, not as an energy transfer system. Ex.-2024, ¶229.

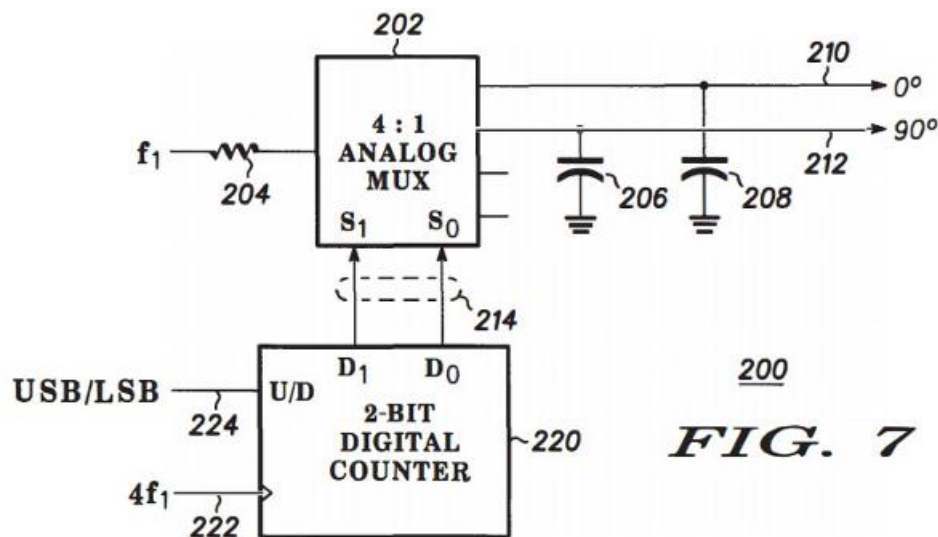
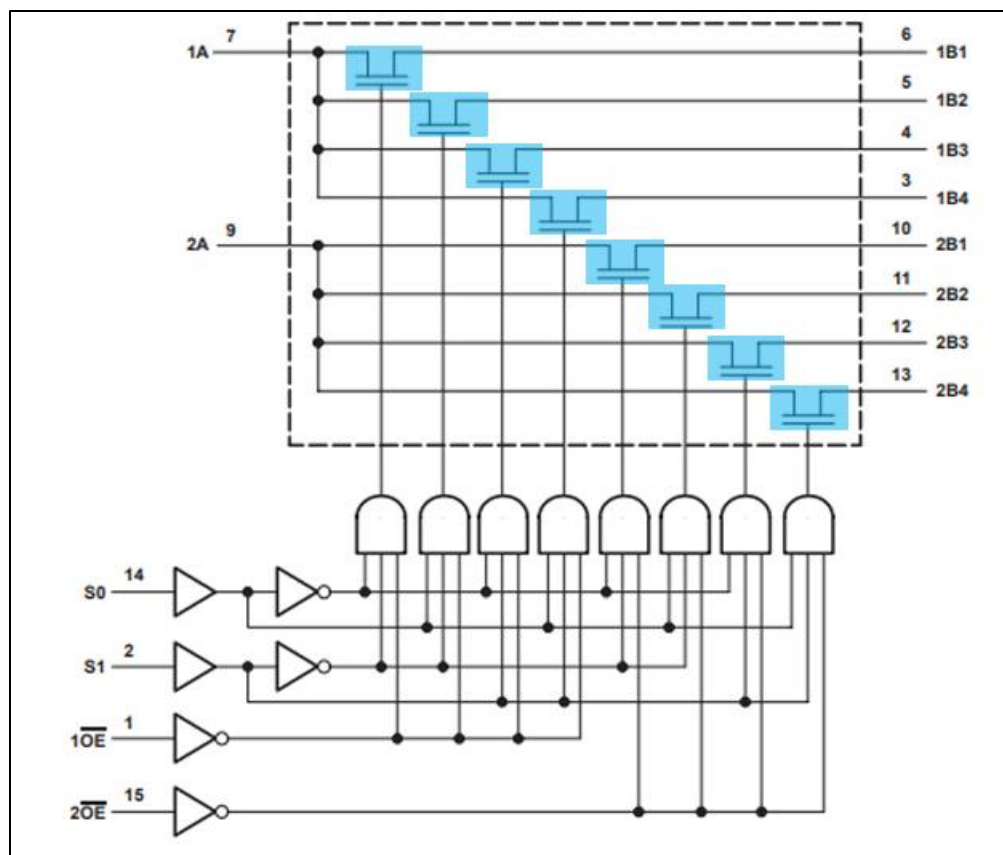


Figure 7 of Tayloe discloses another alternative embodiment of a product detector. Ex.-1004, 5:1-16. If output 210, 212, as well as 180-degree and 270-degree outputs are being used, Figure 7 would be connected to amplifiers 50, 52 just like the product detector of Figure 3. Ex.-2024, ¶¶230-231.

The circuit of Figure 7 works the same as Figures 3 and 5 (depending on how many outputs are used) with regard to holding the average voltages on the capacitors. Thus, Figure 7 of Tayloe is operating as a voltage sampling system, not as an energy transfer (energy sampling) system. Ex.-2024, ¶¶232-233.

B. TI Datasheet

The TI Datasheet discloses a dual 1-of-4 high-speed TTL-compatible FET multiplexer/demultiplexer. Ex.-1005; Ex.-2024, ¶¶234-235.

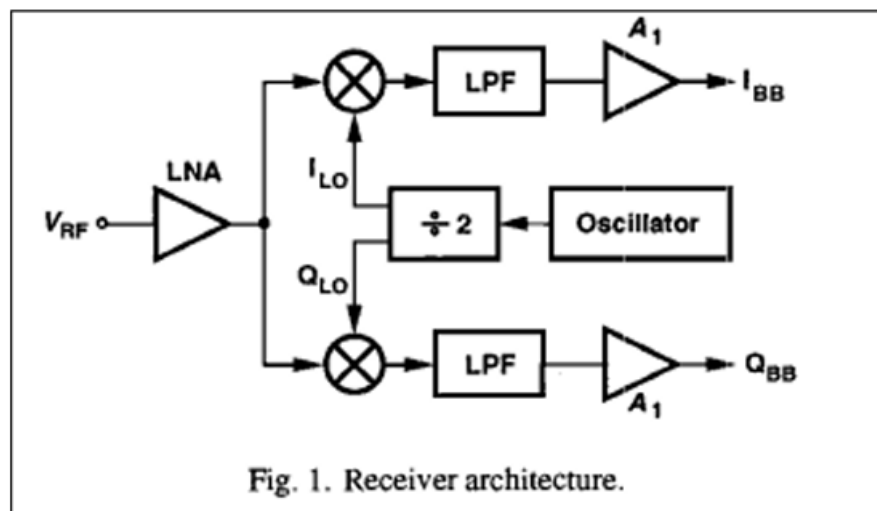


The multiplexer/demultiplexer includes multiple FETs (blue) which are used as switches. Ex.-2024, ¶236.

C. Razavi

Razavi was a research project. Razavi is a voltage-based system that does not transfer energy from the RF input signal to the output of a mixer.

A block diagram of a general DCR architecture is shown in Figure 1 (below). Dr. Razavi explains how he proposes modifying this circuit to create a different type of direct downconverter. Ex.-2024, ¶¶237-239.



The DCR includes a low-noise amplifier (LNA), I/Q mixers, low-pass filters (LPFs), and baseband amplifiers A1. This down-converter was already known at the time Razavi wrote his paper. The I/Q mixers are driven by LO signals. Razavi seeks to avoid the use of passive mixers. Ex.-1017, 113. Accordingly, Razavi uses active mixers. Ex.-2024, ¶240.

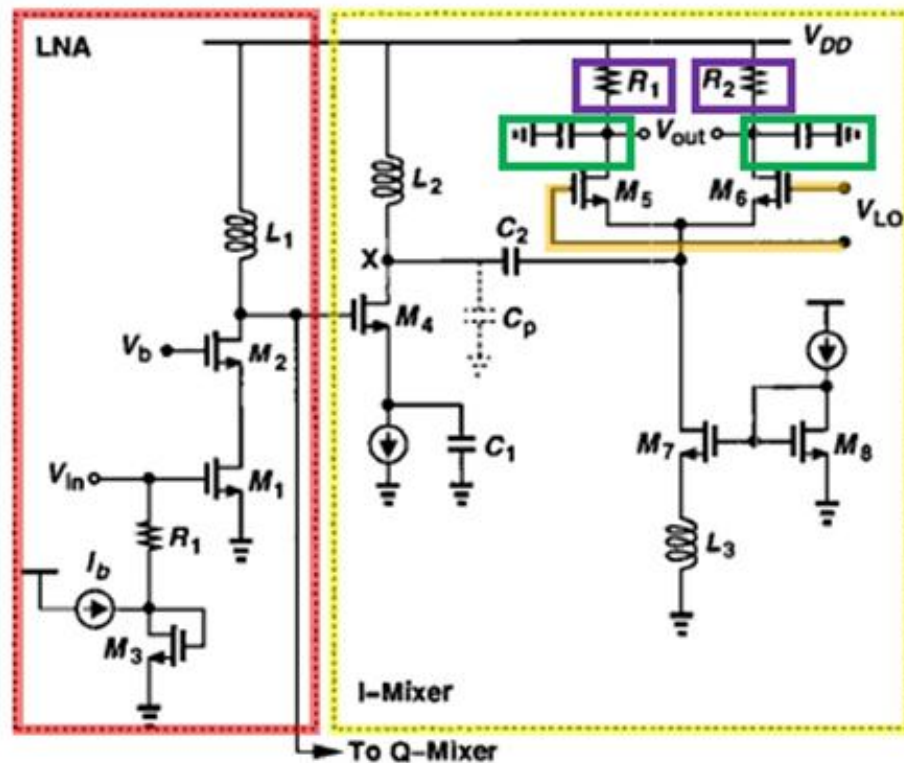


Fig. 2. LNA/mixer implementation.

Figure 2 illustrates the LNA (red box) and I-mixer (yellow box) of Razavi's circuit. The RF signal passes through the LNA and is subsequently received by the I-mixer. Ex.-1017, 113; Ex.-2024, ¶241.

Razavi uses an active mixer (yellow box) with high gain. Razavi creates a new output signal based on the input signal and its modulation information and adds gain to create a copy of that information signal at the output of the mixer. Razavi is using energy from a power supply (represented by V_{DD}) to accomplish this. So unlike an energy sampling (transfer) system, the output signal energy in Razavi comes from a power supply, not from sampled energy of the RF input signal itself. Ex.-2024, ¶242.

Razavi characterizes transistors M5/M6 as a “switching pair,” because they commute the signal current. Transistors M5/M6 are NMOS FETS. Ex.-2034, 203:9-12. The RF input signal is applied to the common node of the source terminals of M5/M6, and drain node of M7. The drain terminals of M5/M6 are connected to VDD through resistors R1/R2. *Id.*, 214:4-7. Ex.-2024, ¶243.

Transistors M5/M6 form a differential pair. M5/M6 pass a DC current that flows from VDD to ground and is controlled by transistor M7. Ex.-2024, ¶244.

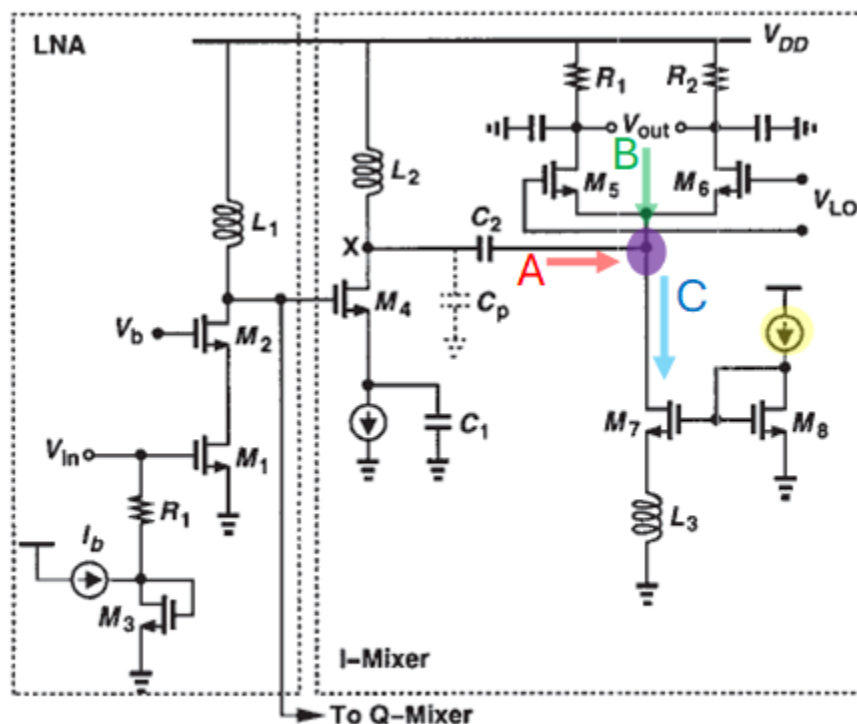
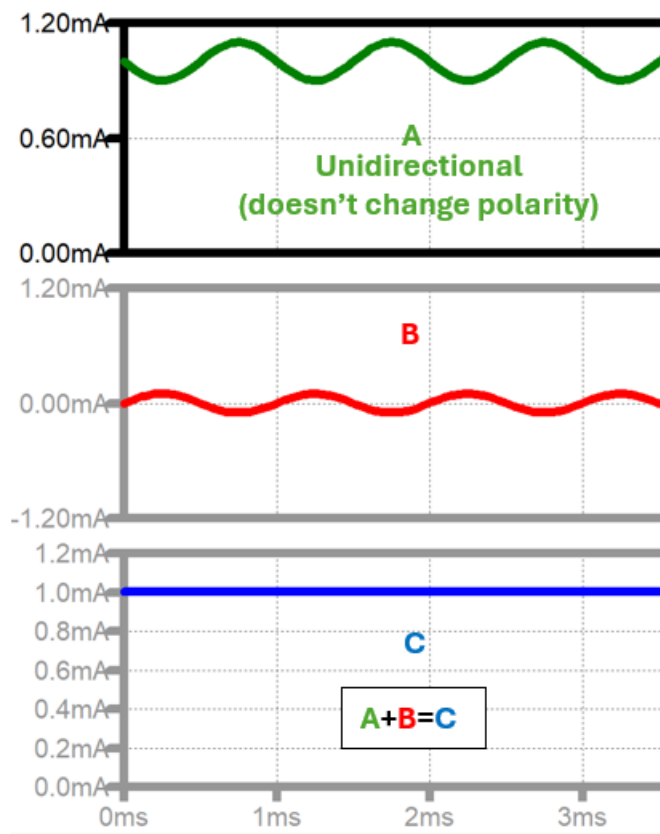


Fig. 2. LNA/mixer implementation.

A POSITA understands that the current flowing through M7 must be direct current (DC). A DC current is mirrored from M8 to M7, as shown by the DC current symbol (yellow). Thus, the current in M7 is also a DC current. Ex.-2024, ¶245.

At the purple node, current A (red arrow) represents the RF input signal flowing into the node. Current C (blue arrow) represents current flowing out of the node through M7. Current B (green arrow) is determined as the difference between current C and current A. Ex.-2024, ¶¶246-247.



As shown above, current B is always a positive number. Because current B is always positive, current is always flowing from VDD to M7. Current B increases or decreases such that when combined with current A, it forms a constant current that flows through M7. Ex.-2024, ¶¶248-249.

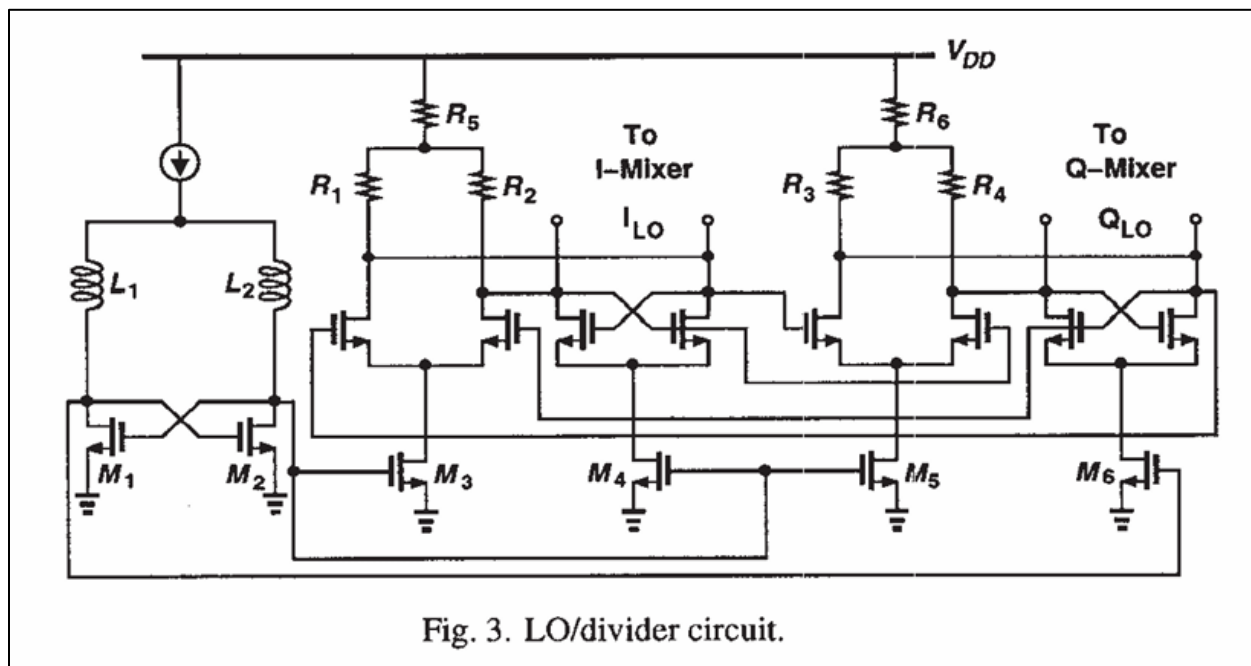
M5 and M6 operate by steering current from VDD through either R1 and M5 or R2 and M6, depending on the LO signal applied to their gates. As the LO signal varies, it modulates the gate voltages of M5 and M6. This affects the flow of current through M5 and M6. When the gate voltage of M5 is substantially greater than that of M6, current flows from VDD, through R1 and M5, and down to M7. When the gate voltage of M6 is substantially greater than that of M5, current flows from VDD, through R2 and M6, and down to M7. Therefore, M5 and M6 simply serve as a current-steering mechanism that routes current from VDD through either R1 or R2 before reaching M7. Ex.-2024,¶250.

Further, Razavi states “[t]o achieve a high conversion gain, M5 and M6 must remain in saturation.” Ex.-1017, 113. For Razavi’s NMOS transistor to remain in saturation, the drain-to-source voltage must be positive, meaning current can only flow from the drain to the source, not the other way.¹⁶ See Ex.-1017, 113; Section III.B.2; Ex.-2024,n10. Current cannot flow from the RF input signal upward through the NMOS transistors from source to drain. Ex.-2024,¶251.

¹⁶ Dr. Galton stated that current can move in both directions in an NMOS transistor when used as a transconductor. Ex.-2004, 245:5-15. He later admitted that M5 and M6 are not used as transconductors. *Id.*, 251:13-15.

Moreover, in Razavi, current flows from VDD downwards towards M5 and M6 from a higher to lower potential. Ex.-2034, 152:19-22, 164:13-166:7, 203:13-19. Current does not flow upwards from M5 or M6 to VDD. Ex.-2024, ¶252.

Though M5 and M6 can modulate the amount of current flowing downward from VDD (Ex.-2034, 167:13-22), they do not reverse the current flow direction. No current flows upward through M5 or M6 toward VDD. Thus, the input signal cannot propagate from the input (source of M5 and M6) to the capacitors or resistors R1/R2. Ex.-2024, ¶253.



A POSITA would recognize that inductors L1 and L2 of Figure 3 produce a sinusoidal output. Ex.-2024, ¶257.

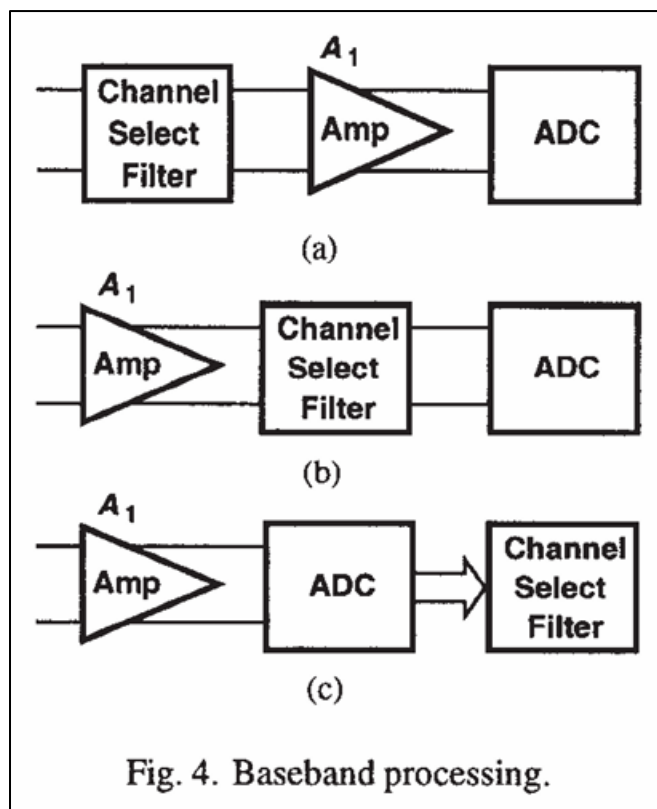
Razavi's capacitors (green boxes above) are solely used for filtering. The mixers (non-sampling mixers) in Razavi's circuit inherently produce high-frequency components and "[t]he output nodes of the mixer [(Vout)] are loaded with on-chip capacitors to suppress high-frequency components." Ex.-1017, 113. In Razavi's configuration, the capacitors do not store and/or integrate energy from the RF input signal to form the down-converted signal. In Razavi's configuration, no energy from the RF input signal is integrated/accumulated in the capacitors, because current only flows downward from VDD to M5/M6. Ex.-2024, ¶259.

Razavi's capacitors are connected to resistors R1/R2 (purple boxes above). Razavi notes that to achieve high conversion gain, in addition to the transistors being in saturation, "and more importantly, the voltage drop across R1 and R2 must be maximized." Ex.-1017, 113. The voltage drop across any resistor depends upon the magnitude of the resistance of that resistor. The higher the magnitude of resistance, the greater the voltage drop across the resistor i.e., resistors R1 and R2 need to be as high resistance/impedance as possible. Ex.-2024, ¶260.

The down-converted signal in Razavi is a voltage and not current (i.e., energy). Figure 2 of Razavi identifies the output of the mixer as a voltage, i.e., Vout Ex.-2034, 161:6-16. Ex.-2024, ¶261.

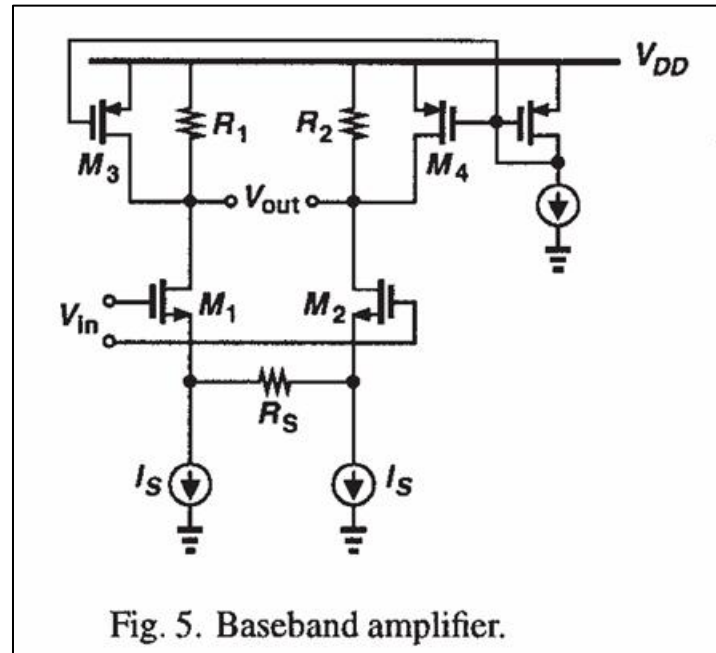
Razavi specifically teaches to use the configurations of Figures 4(b)/4(c). The mixer output (V_{out} , Figure 2) is connected directly to the input of baseband amplifiers (gates of MOSFETS, which is high impedance). Thus, V_{out} is a voltage and no energy is transferred from capacitors in Figure 2. Ex.-2024, ¶262.

Figure 4, below, shows three permutations considered for the circuit following the mixer. Ex.-2024, ¶263.



Razavi teaches away from and criticizes Figure 4(a) because “the low-pass filter design entails severe noise-linearity-power tradeoffs.” Ex.-1017, 113. Notably, Razavi specifies that “[t]he present design is *intended for permutations in Figs. 4(b) and (c).*” *Id.* Ex.-2024, ¶264.

In the configurations of Figures 4(b)/4(c), the mixer stage is followed by a baseband amplifier A1 (below). Ex.-2034, 201:5-11. Ex.-2024, ¶265.



The input of the amplifier (V_{in}) is applied to the gates of transistors M1/M2. Ex.-2034, 202:17-203:5. Thus, amplifier A1 is a high impedance load. Ex.-2034, 117:10-12; 118:5-7. No current or energy is transferred from the mixer to the baseband amplifier—whether from the capacitors or VDD in Figure 2. Ex.-2024, ¶266.

D. U.S. Patent No. 7,065,327

Macnally discloses a direct conversion transceiver. Ex.-1021, Abstract.

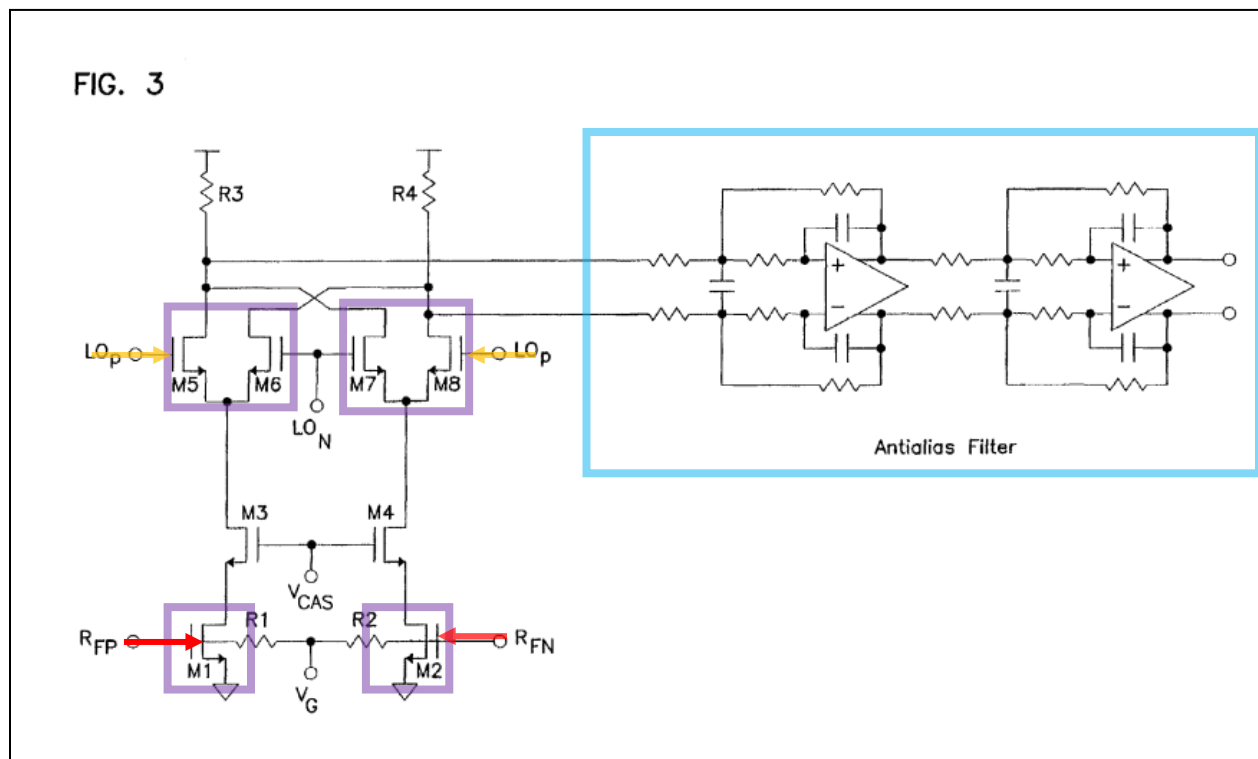
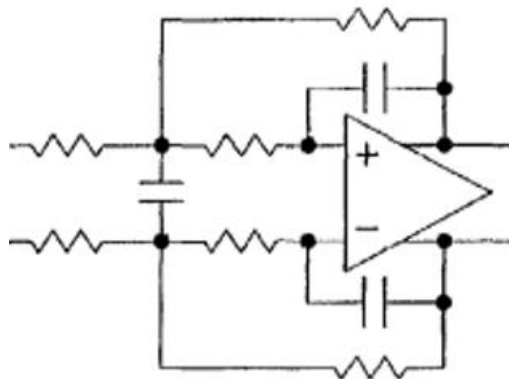


Figure 3 illustrates a circuit diagram of a Gilbert cell double-balanced mixer and antialias filter. Ex.-1021, 7:7-16; Ex.-2034, 57:17-58:5.

The circuit includes a differential RF input signal (red paths), differential LO signal (orange paths), transistors (purple boxes), and an antialias filter (blue box). Ex.-2024, ¶269.



The antialias filter is made up of two biquad two-pole filters (one filter is shown above). Ex.-1021, 7:17-29; Ex.-2034, 56:14-57:5, 288:9-14; Ex.-2024, ¶¶270-271.

MacNally specifies that the mixer's conversion gain is 14.3dB. Ex.-1021, 7:8. Because Macnally's mixer circuit provides gain, the mixer is an active non-sampling mixer. See Section V; Ex.-2024, ¶¶272-273.

IX. VALIDITY OF THE '528 PATENT

A. Neither Tayloe nor Macnally is prior art.

Macnally and Tayloe were filed in September 1998 and October 1998, respectively. Many months earlier, claims 1, 3, 5, 8-9, 11-18 of the '528 patent were conceived of and diligently reduced to practice. Section VI.C. Thus, neither Tayloe nor Macnally is prior art. Accordingly, neither Tayloe nor Macnally can be used to invalidate the claims. Ex.-2024, ¶¶274-275.

B. GROUND 1A

The challenged claims are not obvious over Tayloe/TI Datasheet/Macnally.

See Ex.-2024, ¶¶276-355.

1. Tayloe/TI Datasheet fails to disclose/teach/suggest numerous claimed elements.

Petitioner cannot map numerous claim elements to Tayloe/TI Datasheet. In particular, Tayloe/TI Datasheet does not disclose/teach/suggest (1) a “energy storage element” that stores transferred energy and outputs a baseband signal portion, (2) deriving a baseband signal portion from accumulated transferred energy, or (3) outputting a differential baseband signal (claims 1, 19). Tayloe/TI Datasheet also does not disclose/teach/suggest transferred energy being discharged when a switch is OFF (claims 8, 9, 26, 27). Ex.-2024, ¶¶279-284; *compare* Ex.-1004, Fig. 3 with Ex.-2037, pp. 523 (Fig. 10.1-3(a) sample-and-hold circuit) (Tayloe and Fig. 10.1-3(a) both show a switch and the output of a capacitor directly connected into an amplifier).

Moreover, the Federal Circuit held that voltage samplers such as Tayloe are different than ParkerVision's energy transfer/sampling technology. *ParkerVision* 116 F.4th at 1349.

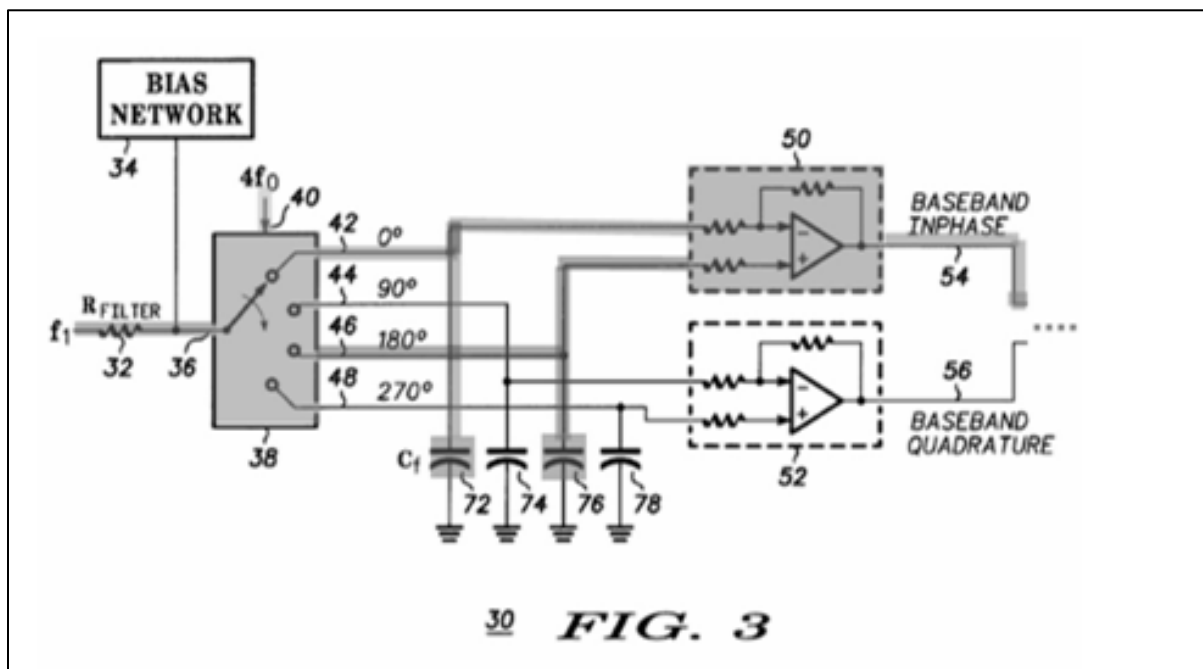
Thus, Petitioner builds a completely new circuit, replacing Tayloe's amplifier with Macnally's biquad two-pole filter. See, *e.g.*, Ex.-1003, ¶¶153,160,173. But this

fundamentally changes how Tayloe's circuit operates to accurately read voltage.

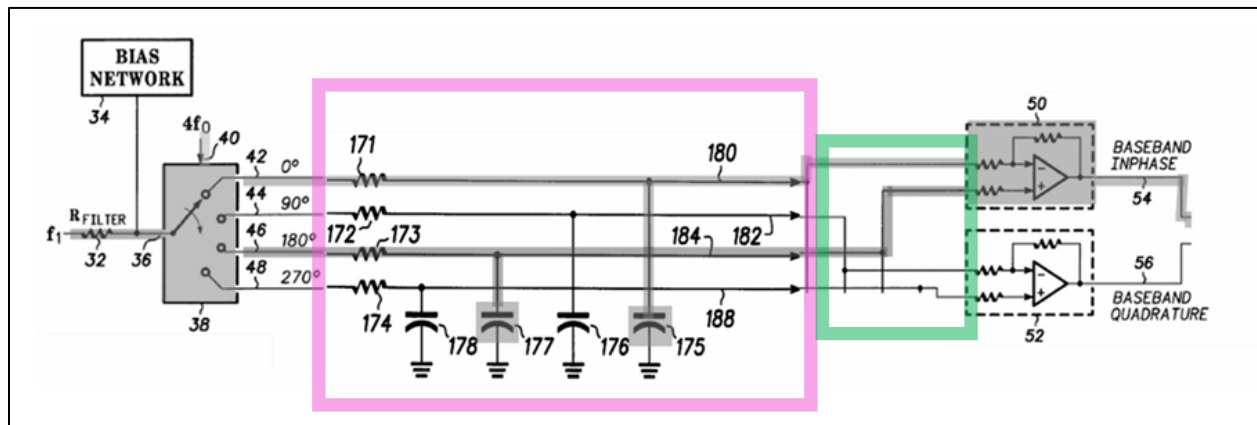
Ex.-2024, ¶285.

2. There is no motivation to combine.

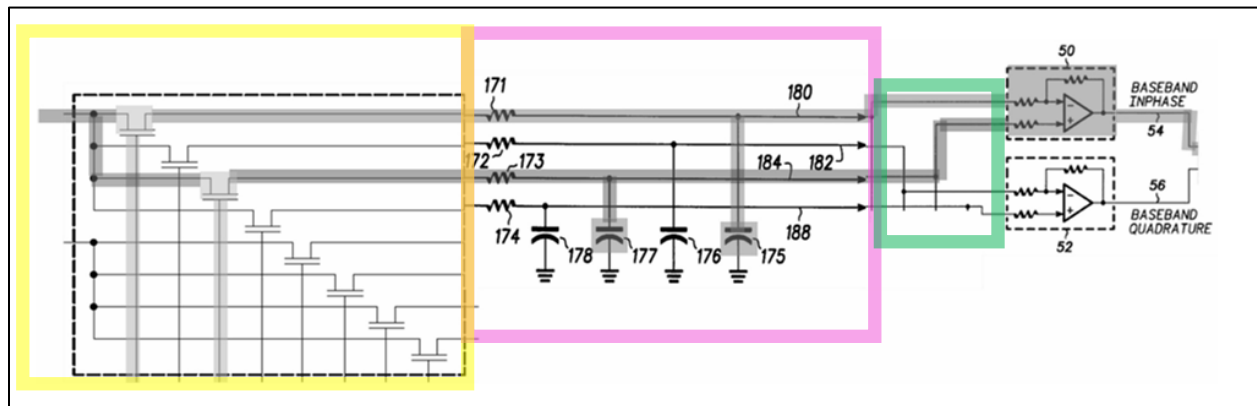
Petitioner alleges that it would be obvious to combine Tayloe/TI Datasheet/Macnally. Not so.



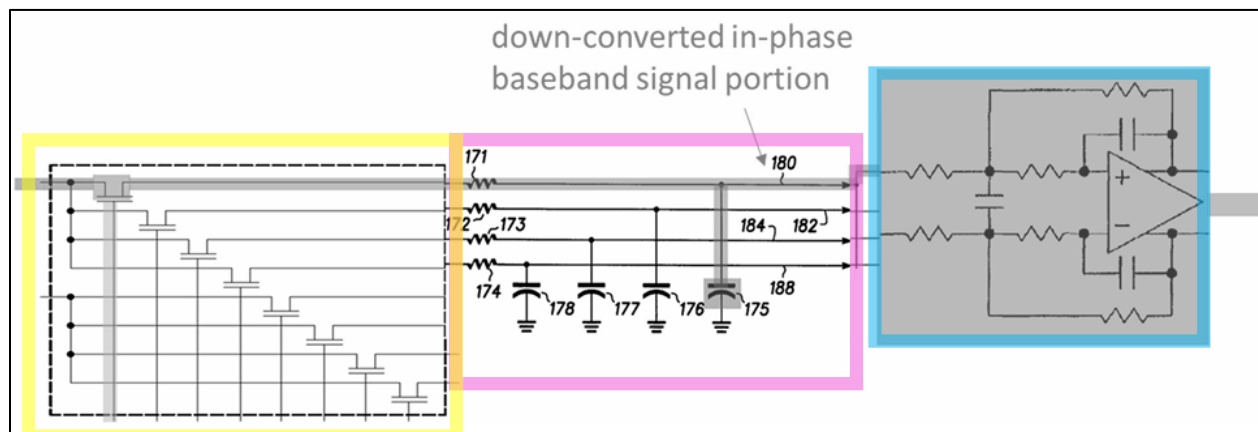
First, Petitioner begins to build an entirely new circuit using Figure 3 of Tayloe (above). Ex.-1003, p. 71.



Second, shown above, Petitioner replaces the middle portion of Figure 3 with Figure 6 (pink box). *Id.* Third, Petitioner creates new circuit connections (green). *Id.*



Fourth, Petitioner replaces Figure 3's commutating switch 38 with the TI Datasheet multiplexer (yellow box above). *Id.*



Finally, Petition replaces Tayloe's amplifier with Macnally's biquad two-pole filter (blue box above). *Id.*, pp. 73, 81; Ex.-2024, ¶¶287-292.

Petitioner uses the patented invention as a roadmap to reconstruct a completely new circuit. Petitioner does so without analyzing how each substitution would affect circuit functionality. Ex.-2024, ¶293.

Petitioner's combination is pure hindsight based on the '528 patent. Ex.-2024, ¶294.

a. Tayloe teaches away from using Figure 6 with the TI Datasheet multiplexer

It would not be obvious to use Tayloe's Figure 6 in combination with the TI Datasheet multiplexer. Ex.-2024, ¶295.

Tayloe only discloses using the TI Datasheet multiplexer in the context of Figures 3 and 7. Ex.-1004, 5:31-37. Nowhere does Tayloe discuss/suggest using a multiplexer with Figure 6. And Petitioner's basis to use the multiplexer with Figure

6 (Pet. 24, 26) ignores critical distinctions among embodiments. Ex.-2024, ¶¶296-297.

The configuration of Figures 3 and 7 is different than that of Figure 6. And Tayloe specifically chose not to use the multiplexer with Figure 6. Unlike Figure 6, Figures 3 and 7 use a *shared* resistor configuration — a *single* resistor and individual capacitors. Figure 6, however, uses a *per-path* resistor configuration — four separate resistors, one for each capacitor. The multiplexer-based implementation is expressly tied to the shared-resistor configuration in Figures 3 and 7. Tayloe never discloses/teaches/suggests combining the multiplexer with the more complex and component-heavy configuration of Figure 6. Ex.-2024, ¶298.

Petitioner does not provide any reason for departing from Tayloe's disclosed design choice. Doing so undermines the very design tradeoffs Petitioner claims would motivate a POSITA to adopt the proposed Tayloe-Macnally-TI Datasheet combination in the first place. Ex.-2024, ¶299.

If, as Petitioner contends, a POSITA is considering “size, packaging advantages, and low unit cost” (Ex.-1003, ¶141; Pet. 28) of an integrated circuit (IC), then the simpler architecture of Figure 3—which uses fewer components, reduces layout complexity, and minimizes die area and power consumption— would be

preferred to Figure 6's per-path resistor structure—which introduces greater component count, routing complexity, and cost. Ex.-2024,¶300.

Figure 6 also introduces substantial practical complications. In an IC context, using Figure 6 would require precise matching of the four resistors in order to maintain equal time constants across signal paths which is necessitated by Petitioner's proposed combination. This level of matching is difficult to achieve due to variation in IC fabrication processes. A mismatch would introduce distortion or imbalance in the signals. Achieving such matching would necessitate larger resistors (increasing die area) and/or post-fabrication calibration—both of which run counter to the alleged design goals of simplicity/reducing costs. But these burdens are not present in Figure 3's design, which does not require matched per-path resistors. That Petitioner instead relies on Figure 6 contradicts the very design tradeoffs Petitioner alleges would motivate the combination with Macnally. Ex.-2024,¶301.

Finally, it is not as simple as just substituting Figure 6 for Figure 3. Using Figure 6 with the TI Datasheet multiplexer introduces complexities that Figure 3 does not have. Whereas Figure 3 uses a single resistor R_{FILTER} before the switch, Figure 6 uses four separate resistors after the switch. This distinction has meaningful consequences for signal timing, die layout, and implementation in silicon. Petitioner

offers no evidence or reasoning to support that a POSITA would willingly introduce these complexities counter to Petitioner's own rationale. Ex.-2024, ¶¶302-303.

b. Tayloe teaches away from creating Petitioners' integrated circuit

Petitioner asserts that a POSITA would be motivated to adapt Tayloe's circuit as an integrated circuit (IC) "to meet relentless market demand for improved product size/performance, and decreased unit cost." Pet., 28.

But Tayloe provides no motivation for a POSITA to develop an IC incorporating Tayloe's product detector. In fact, Tayloe already discloses use of an integrated circuit—the TI Datasheet multiplexer. Tayloe, however, never discloses/teaches/suggests integrating its product detector into the TI Datasheet IC or any other IC. A POSITA would not have been motivated to develop an entirely new integrated circuit around Tayloe's product detector. Ex.-2024, ¶305.

To the contrary, a POSITA would understand that Tayloe specifically teaches away from implementing its product detector in an IC. Ex.-2024, ¶306. Petitioner's proposed circuit includes Tayloe's capacitors. A POSITA would recognize that Tayloe's capacitors would not be suitable for integration due to their large size. *Id.* Specifically, a POSITA understands that capacitances larger than 1 pico-Farad are difficult/generally impractical due to on-chip space and process limitations. *Id.* Yet, the embodiment disclosed in Tayloe uses a 0.3 microfarads capacitor—300,000 times

larger than what is considered feasible (1 pico-Farad) in an IC. *Id.*; Ex.-1004, 5:50-51. Thus, a POSITA would recognize Tayloe's capacitors would be off chip—i.e., not integrated. Ex.-2024, ¶306. Notably, Dr. Galton ignores this. Ex.-1003, ¶141; Ex.-2024, ¶306.

Moreover, Tayloe specifically states that a “*prototyped* direct conversion receiver” was built using the circuit of Figure 3. Ex.-1004, 5:49-50. Tayloe admits that the prototype could not handle higher frequency signals which were “many orders of magnitude greater than the prototyped unit.” *Id.*, 5:34-59. While Tayloe states that higher-frequency receivers were possible to build, Tayloe provides no example/guidance on how to achieve this. Notably, as discussed below, the TI Datasheet multiplexer cannot support higher frequencies because it cannot switch fast enough. Ex.-2024, ¶307.

Thus, a POSITA would recognize that building an IC with Tayloe's product detector/TI Datasheet would require redesigning the circuit architecture, abandoning the TI multiplexer, and developing new switching components capable of operating orders of magnitude faster than those disclosed in Tayloe/TI Datasheet. Doing so would require undue experimentation, well beyond routine skill in the art. Ex.-2024, ¶308.

Thus, Tayloe does not provide any motivation to create an IC using Tayloe/TI datasheet. Tayloe teaches away from such a design. Petitioner's proposal relies on hindsight and ignores real-world engineering constraints. Ex.-2024,¶309.

c. Macnally-TI Datasheet are not compatible

A POSITA would not combine the TI Datasheet and Macnally in an IC. Ex.-2024,¶310.

Petitioner's stated motivation for using Macnally is to realize the entire system as a single IC. Ex.-2024,¶311.

Macnally is realized in IC technology, in part, because it operates at high frequencies, e.g., 915 MHz (Ex.-1021, Figs. 6 and 10), which enables the use of physically smaller components, making it feasible for an IC. Ex.-2024,¶312.

At 915 MHz, the signal period is approximately 1.09 nanoseconds. The TI Datasheet multiplexer, however, cannot switch quickly enough to function at that rate.¹⁷ The switches in the TI Datasheet cannot turn ON and OFF fast enough to handle 915 MHz. Ex.-2024,¶313.

In particular, Tayloe describes switches being ON for one-quarter ($\frac{1}{4}$) of a full cycle. At 915 MHz, that would be 273 picoseconds. For the circuit to function, the

¹⁷ The TI Datasheet multiplexer only worked with Tayloe because Tayloe operated at 7MHz. Ex.-1004 5:49-50.

switches in the TI Datasheet multiplexer would need to turn ON, allow current to flow through it, and then turn OFF all within 273 ps. To be practical, the switch ON/OFF time must be only a small fraction of this—27.3 ps. The TI Datasheet shows that the response time of the switches is at least an order of magnitude slower. Ex.-2024, ¶314.

As shown in Figure 1 from the TI Datasheet, the propagation delay through a switch is 0.25 ns (250 ps), which nearly consumes the entire allowable ON time. Even worse, the turn ON delay from the command signal is t_{plz} which is equal to t_{dis} (Note E., Figure 1). This is 1.1 ns at the minimum and can vary as large as 7.4 ns. These values are all substantially longer than the 1.09 ns full cycle of a 915 MHz signal and far exceed the 27.3 ps transition time noted above. Ex.-2024, ¶315.

d. Macnally's teaches a fundamentally different mixer than Tayloe

Dr. Galton ignores that his combination is replacing Macnally's mixer with Tayloe/TI Datasheet. Dr. Galton fails to show any motivation for replacing Macnally's mixer, which achieves significant gain. Ex.-2024, ¶316.

Specifically, Macnally discloses a high-performance mixer. Ex.-1021, 7:8-10; Section VIII.D. Tayloe, however, discloses a mixer with a -1dB conversion loss, which is 15 dB less gain (worse) than Macnally. Ex.-1004, 1:65; 3:5-6, 9-11. The gain achieved in Macnally is not due to the biquad two-pole filter. Ex.-2024, ¶317.

e. There is no motivation to replace Tayloe's amplifiers with Macnally's filter

Petitioner asserts that a POSITA would be “inspired by several known advantages of using fully differential amplifiers and Macnally's topology for baseband processing on an IC.” Pet. 28; Ex.-1003, ¶141. Based on this, Petitioner asserts that a POSITA would be motivated to replace Tayloe's amplifiers with Macnally's biquad two-pole filters.

Petitioner lists a few purported benefits of using a fully differential amplifier, which has a *differential* output. Pet., 28-30. But there is no reason for a POSITA to even consider using a fully differential amplifier. Ex.-2024, ¶¶318-319.

First, Tayloe specifically teaches using an amplifier with a single-ended output for a specific goal, namely “to increase gain.” Ex.-1004, Abstract; Ex.-2024, ¶320.

Tayloe's amplifier 50, 52 are used to amplify the signal and provide gain. Because Tayloe's amplifiers already accomplish the intended goal of providing gain, a POSITA would not have any reason to replace Tayloe's amplifiers with a different type of circuit. Thus, a POSITA would not be motivated to look to Macnally's biquad two-pole filter to perform amplification. Ex.-2024, ¶¶321-322.

Nevertheless, Petitioner inexplicably proposes replacing Tayloe's amplifiers with an entirely different type of circuit. Unlike Tayloe's design, which provides a

single-ended output, Macnally's filter produces a differential output. The difference is significant, as Tayloe deliberately uses a single-ended output to increase gain. Petitioner's proposed substitution undermines Tayloe's intended functionality. Ex.-2024,¶323..

Second, Macnally's biquad two-pole filter acts as a low-pass (anti-alias) filter. Ex.-1021, 7:17-19; Ex.-1003,¶143; Ex.-2034, 56:5-57:16. An anti-aliasing filter removes aliased signals from the band of operation. Tayloe, however, already achieves low-pass filtering using RC time constants created by resistor and capacitors in Figure 3 or 6. Ex.-1004, 2:14-15, 3:21-27; Ex.-2034, 145:2-9; Ex.-2024,¶324.

Tayloe does not identify or discuss any need for any additional filtering or anti-aliasing components. This is because Tayloe already performs the function of an anti-aliasing filter—removing aliasing artifacts. Thus, a POSITA would not be motivated to look at filtering technology such as Macnally's biquad two-pole filters to incorporate into Tayloe's circuit. Ex.-2024,¶325. And a POSITA would certainly not look to replace an amplifier with a filter, regardless of whether that filter also happens to amplify a signal. *Id.*

Notably, Petitioner simply provides no rationale for why an additional low-pass filter is needed when there is a low-pass filter that is already part of Tayloe's product detector. Ex.-2024, ¶326.

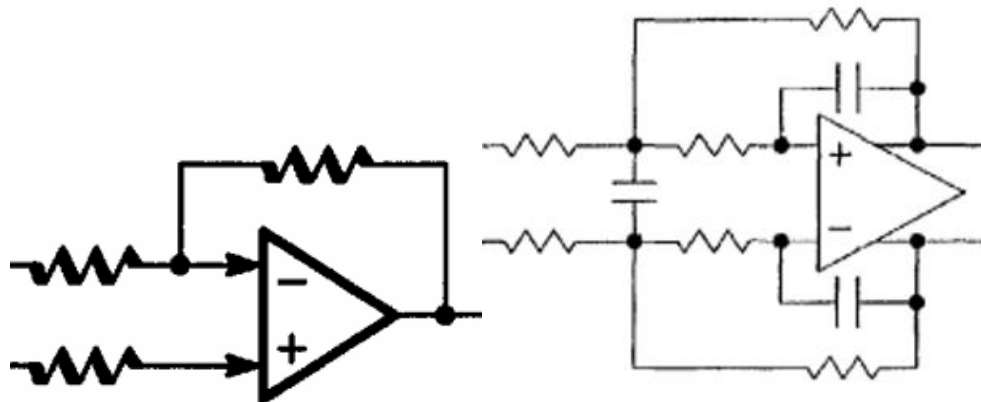
Third, Petitioner attempts to justify replacing Tayloe's amplifiers with Macnally's biquad two-pole filters by suggesting problems with Tayloe's circuit. Pet. 28, 29. But Tayloe already addresses these purported problems. Ex.-2024, ¶327; *see also Runway Safe LLC v. Engineered Arresting Systems*, IPR2015-01921, Paper 9, 6-8, 10-11 (PTAB Feb. 29, 2016) (no motivation to combine because a POSITA would have had no reason to solve a problem that does not exist or was already addressed).

In particular, Petitioner asserts that by taking the difference between “two complementary signal components,” Macnally's biquad two-pole filter offers advantages such as cancelling interference, minimizing harmonic distortion, and improving linearity Pet. 28. Tayloe's amplifiers already process complementary inputs and achieve the same results. Thus, there is no motivation to replace Tayloe's amplifiers with Macnally's biquad two-pole filters. There is no technical reason a POSITA would look to Macnally for Petitioner's alleged improvements. Ex.-2024, ¶328.

Petitioner also asserts that fully differential amplifiers provide symmetrical layouts in ICs, which can minimize noise. Pet., 28. But Tayloe already addresses the issue of noise. Ex.-1004, 3:4-13 (“The Tayloe Product Detector can exhibit less than 1 dB of conversion loss, ...[which] translates into a 6-7 dB improvement in overall receiver noise figure....”). These are precisely the performance concerns Petitioner claims would motivate a POSITA to seek alternatives. But Tayloe already solves them. Accordingly, a POSITA would not think to look to Macnally's biquad two-pole filter. Ex.-2024, ¶329.

Petitioner further suggests that Macnally's biquad filter uses a “Rauch biquad topology known for reducing the number of operational amplifiers on an IC.” Ex.-1003, ¶141; Pet. 28. But using Macnally's biquad two-pole filter in Tayloe's circuit would require more components (not fewer) than Tayloe's existing amplifier design. Ex.-2024, ¶¶330-331.

Specifically, Petitioner proposes a one-for-one replacement of Tayloe's amplifiers with Macnally's filters. Thus, Petitioner's proposal uses at least the same number of op-amps disclosed in Tayloe. Ex.-2024, ¶332.



Further, Taylor's amplifiers (above left) has significantly fewer components than Macnally's filter (above right). Ex.-2024, ¶333.

Moreover, Taylor's amplifier produces a single-ended output, while Macnally's biquad two-pole filter produces a differential output. Macnally's differential output would therefore require additional subsequent circuitry (that Taylor's amplifier does not need). Thus, a POSITA would not be motivated to use Macnally's biquad two-pole filter to reduce the number of components or op-amps. Ex.-2024, ¶334.

Accordingly, Petitioner fails to provide any reason why a POSITA would substitute Macnally's biquad two-pole filter for Taylor's amplifier. The circuits are not functionally equivalent, and the substitution would increase complexity without offering meaningful benefits. Ex.-2024, ¶335.

Fourth, Petitioner asserts that, in developing an IC, a POSITA would consider "size, packaging advantages, and low unit cost." Ex.-1003, ¶141; Pet. 28. Using

Tayloe Figure 6 and Macnally's biquad two-pole filter, however, would significantly increase (not decrease) the number of components needed to achieve the same result. Figure 6 uses *more* resistors than Figure 3 and Macnally's filter requires many *more* components than Tayloe's amplifier and additional subsequent components to process the differential signal. Ex.-2024,¶336.

Fifth, Tayloe describes the invention as “a simple and inexpensive product detector,” with performance benefits such as “low conversion loss” and “substantial receiver performance gains.” Ex.-1004, 1:65; 3:5-6, 9-11. These performance characteristics address the very issues that Petitioner alleges would drive a POSITA to incorporate Macnally. Ex.-2024,¶337.

Finally, a POSITA would not look to Macnally for components. Tayloe and Macnally are fundamentally different systems. Tayloe is a sampling system whereas Macnally discloses a Gilbert cell mixer (non-sampling mixer). See Ex.-2034, 102:11-14, 104:7-18, 57:17-58:5. Sections IV; VIII.A, D. Tayloe uses a 25% duty cycle mixer whereas Macnally uses a nominal 50% duty cycle mixer. Ex.-2034, 59:3-16, 59:17-60:12, 104:21-105:3; *see also* Ex.-2024,¶338.

3. Tayloe-Macnally are not compatible.

A POSITA would not be motivated to replace Tayloe's amplifiers with Macnally's biquad two-pole filters, because the two circuits are fundamentally

incompatible. And the combination changes the fundamental nature of Tayloe. Ex.-2024,¶339.

As explained in Section VIII.A above, Tayloe is a voltage sampling system and Tayloe's amplifiers operate as *high* impedance loads. This high input impedance ensures Tayloe's capacitors retain charge during the sampling cycle and establish a stable voltage. Ex.-2024,¶340.

Petitioner, however, propose replacing Tayloe's amplifiers with Macnally's filter. But, according to Petitioner, Macnally's filter presents a *low impedance* load. Pet. 35, 70, 72; Ex.-1003 ¶ 240. A POSITA would understand that substituting a low impedance load in place of a high impedance load would fundamentally alter the operation of Tayloe's circuit. In particular, a low impedance load would draw current from Tayloe's capacitors during the sampling cycle, altering voltage levels in the capacitors and preventing an accurate voltage reading. Ex.-2024,¶341.

This is not a minor/superficial difference. High and low impedance loads produce materially different effects in analog circuits. A high impedance load is required to preserve charge on the capacitors and maintain accurate voltage representations. A low impedance load discharges stored charge, distorting the intended signal output and corrupting the sampled signal. Making this substitution

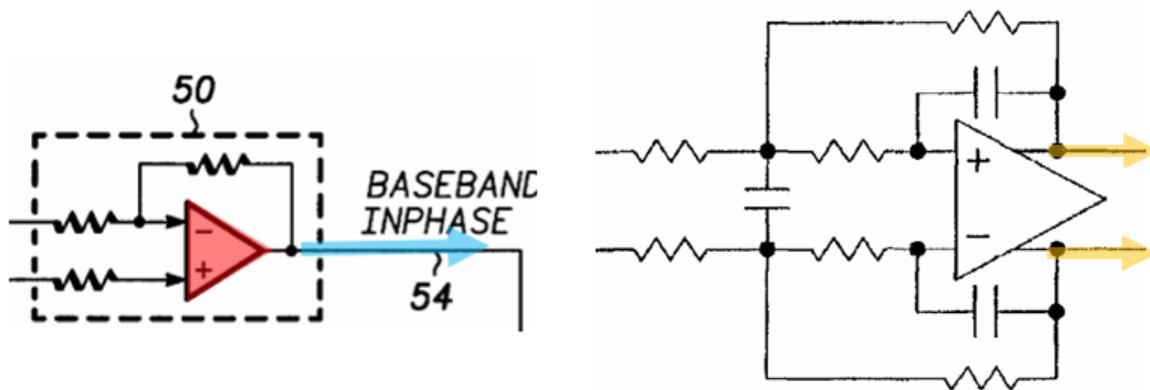
would not only alter the behavior of the circuit but would defeat the very function Tayloe's architecture is designed to serve. Ex.-2024, ¶342.

The incompatibility between Tayloe's amplifier and Macnally's filter would therefore dissuade, not encourage, a POSITA from making Petitioner's proposed substitution. Ex.-2024, ¶343.

4. There is no reasonable expectation of success in combining Tayloe/TI Datasheet and Macnally into an IC.

Petitioner alleges that replacing Tayloe's amplifiers with Macnally's filters is "a simple substitution of one known element ... to obtain predictable results ...and [] would have had a reasonable expectation of success." Pet., 29-30; Ex.-1003, ¶143; Ex.-2024, ¶344.

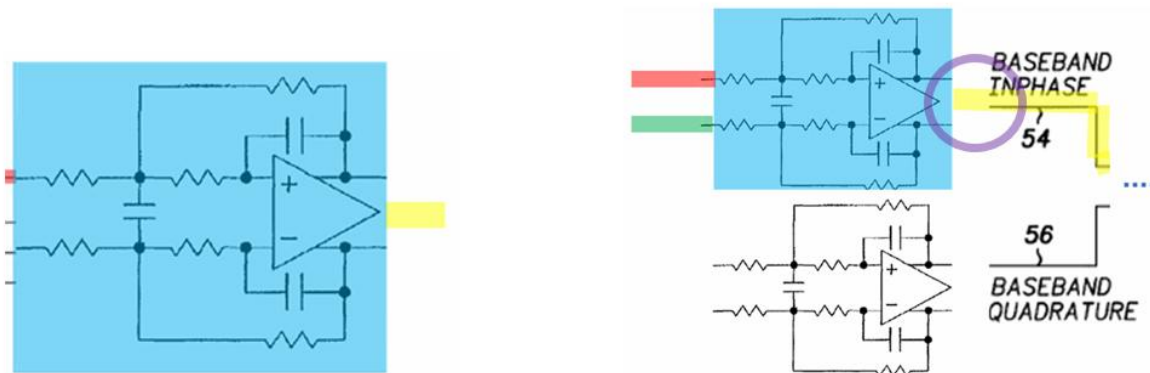
Replacing Tayloe's amplifiers with Macnally's requires fundamental restructuring of Tayloe's circuit that will not produce predictable results or have a reasonable expectation of success. Ex.-2024, ¶345.



First, Tayloe's amplifiers (above left) use a *single-ended* output. In contrast, Macnally's filters (above right) use *differential* outputs. Incorporating Macnally's biquad two-pole filter into Tayloe's circuit would fundamentally change the signal paths and negate the gain benefits that Tayloe describes. Ex.-2024,¶346.

Implementing Macnally's differential output in place of Tayloe's single-ended output would require redesigning the rest of Tayloe's signal chain to accommodate Macnally's differential output configuration. Ex.-2024,¶347. Even Petitioner acknowledges this. Pet., 29.

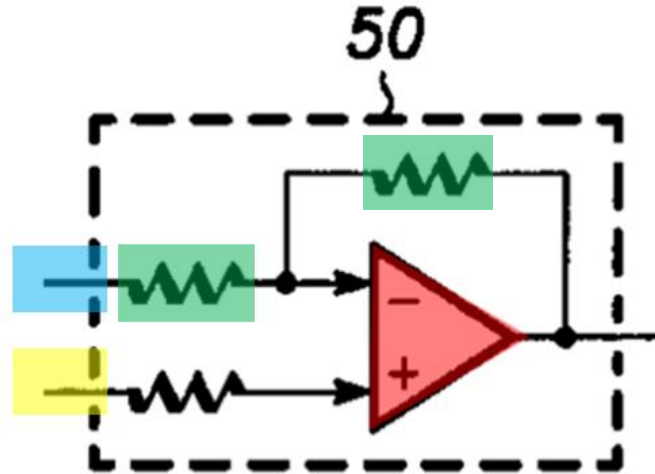
These changes would not lead to predictable results or a reasonable expectation of success. Petitioner is proposing replacing a simple amplifier of Tayloe with a complicated circuit—Macnally's Rauch biquad two-pole filter (as well as additional subsequent circuitry). Further, adding a biquad two-pole filter into Tayloe's system would also require considerable experimentation to figure out how to design Tayloe with a complicated circuit—Macnally's Rauch biquad two-pole filter. A POSITA would need to engage in substantial experimentation to determine how (or whether) such a filter could function in Tayloe's circuit. And there is no guarantee that the newly designed circuit would have improved linearity and reduced power consumption for on-chip performance compared to using Tayloe's amplifier and subsequent circuitry. Ex.-2024,¶348.



Notably, as shown above, Dr. Galton did not even provide any indication of what circuitry would exist after Macnally's filter or how it is configured or would operate. Ex.-1003, ¶¶153, 167; Ex.-2024, ¶349.

Second, replacing Tayloe's single-ended amplifier with Macnally's filter would alter the fundamental operation of Tayloe's circuit. Ex.-2024, ¶350; *Plas-Pak Industries v. Sulzer Mixpac AG*, 600 Fed. Appx. 755, 757-58 (Fed. Cir. 2013) (“[C]ombinations that change the ‘basic principles under which the prior art was designed to operate,’ or that render the prior art ‘inoperable for its intended purpose’ may fail to support a conclusion of obviousness.”).

Tayloe specifically shows a differential amplifier with a single-ended output to improve gain. Using Macnally's biquad two-pole filter with a differential output changes that configuration considerably. Ex.-2024, ¶351. Moreover, as discussed in Section VIII.A, Tayloe's amplifiers are high impedance loads. *Id.*



As discussed in Section VIII.A, a POSITA understands that the yellow and blue inputs (above) of amplifiers 50, 52 exhibit very high resistance/impedance. According to Petitioner, Macnally's biquad two-pole filter provides a *low impedance load* Pet., 35, 70. As explained in Sections III.B.5 and VI.B, high and low impedance loads have very different effects on a circuit. Ex.-2024, ¶352.

A POSITA would therefore not be motivated to replace Tayloe's amplifiers with Macnally's filters. Such a modification would ignore all of the disclosure in Tayloe, abandon all of the teachings/suggestions of Tayloe, and fundamentally change the Tayloe's circuit. Ex.-2024, ¶353.

Third, Petitioner asserts that "a POSITA would have recognized that the lowpass filtering function of the Macnally differential amplifier is beneficial...." Ex.-1003, ¶143. But Tayloe already incorporates a low-pass filter and achieves low-pass filtering. Petitioner never explains how adding a second filtering stage—or

replacing Tayloe's RC filtering with Macnally's filters—would affect the circuit's frequency response. Ex.-2024,¶354.

C. GROUND 2: Razavi–Macnally

The challenged claims are not obvious over Razavi/Macnally. *See* Ex.-2024,¶¶356-415.

1. Razavi does not disclose/teach/suggest transferring energy from a modulated carrier signal as an output of a switch when the switch is ON (claims 1 and 19).

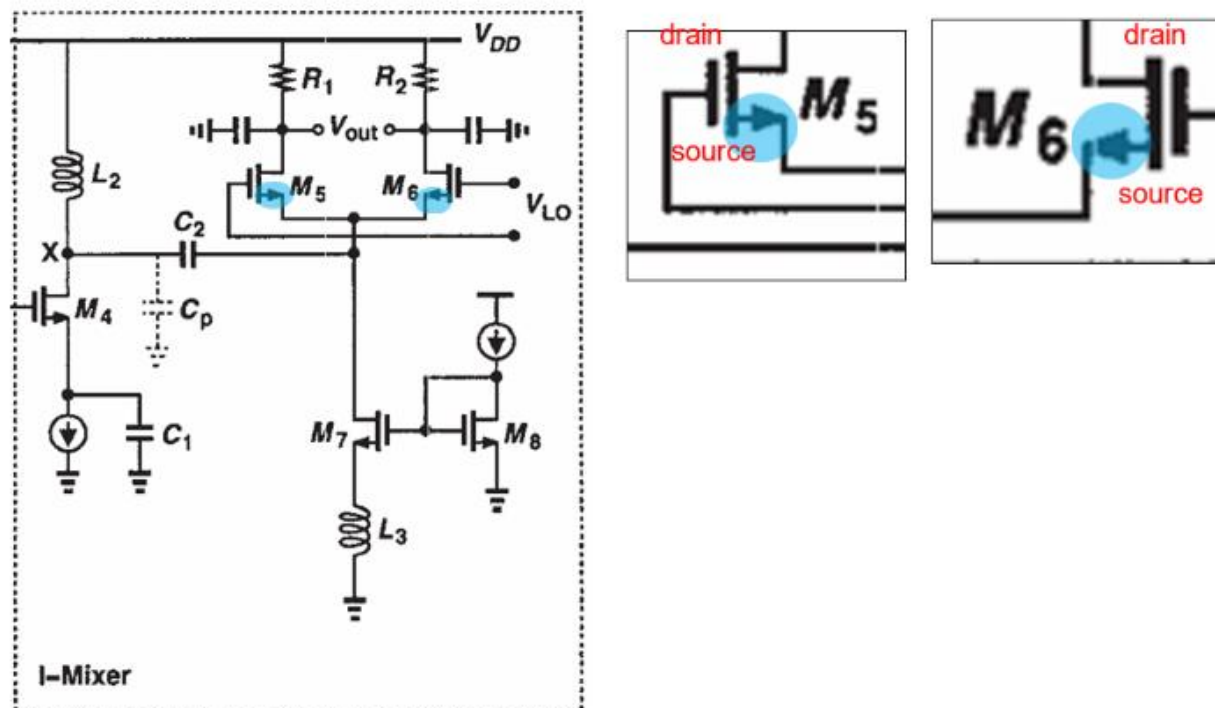
A POSITA understands that sampling, in this context, refers to reducing a continuous-time signal to a discrete-time signal. *See* Ex.-2030; Sections III.B.9, IV.B, VI.B. Notably, Razavi does not sample. Ex.-2024,¶359.

Dr. Galton points to transistors M5 and M6 in Razavi's mixer as the alleged “switches” and the RF input signal as the modulated carrier signal. Ex.-1003,¶¶231-232, 236-237. Dr. Galton asserts that Razavi's mixer performs sampling and transfers energy from the modulated carrier signal, because the LO signal opens and closes transistors M5 and M6. Ex.-1003,¶¶231-232. Neither M5 nor M6, however, transfers energy from the modulated carrier signal as an output even if M5 or M6 is ON. Dr. Galton's explanation of how Razavi's mixer works is incorrect. Ex.-2024,¶360.

As explained in Section VIII.C above, Razavi's mixer does not sample the RF input signal. The RF input signal does not—and cannot—pass through transistors

M5 or M6. And because the RF input signal cannot pass through transistors M5 and M6, energy is never transferred as an output of M5 or M6 even if they are ON. Ex.-2024,¶361.

Transistors M5 and M6 operate in saturation. Sections VIII.C Thus, current can only flow through M5 to M6 in one direction —downward from the drain to the source. Because the RF input signal cannot propagate through M5 or M6, energy is not transferred to the output of M5 or M6 even if M5 or M6 are ON. Ex.-2024,¶362.



Indeed, the NMOS symbols for M5 and M6 depict arrows indicating the direction of current flow—from the drain to the source. Ex.-2024,¶¶363-364.

Even assuming, as Dr. Galton asserts, that transistors M5 and M6 are switches that open and close, this would not change the fact that no current from the RF input signal passes through M5 or M6 from the source to the drain. Ex.-2024, ¶365.

Moreover, a POSITA understands that current flows from a higher potential to a lower potential. Ex.-2034, 152:19-22. In Figure 2 (shown below), VDD is the highest potential in the circuit. Consequently, current flows downward from VDD, through resistors R1 and R2, transistors M5, M6, and M7, and ultimately to ground. Even assuming transistors M5 and M6 turn ON the only direction of current flow remains downward from VDD to ground. *Id.*, 164:13-21; Ex.-2024, ¶¶366-367.

Figure 2 of Razavi (annotated below) illustrates the actual current flow. Ex.-2024, ¶369.

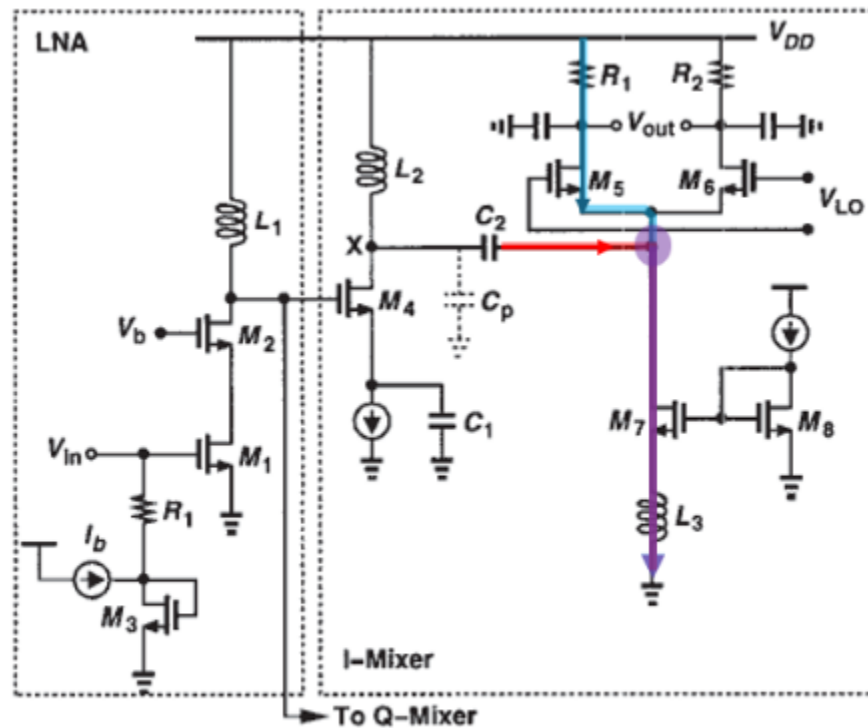
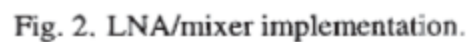


Fig. 2. LNA/mixer implementation.

In a first scenario (above), current from V_{DD} (blue arrow) flows downward through R_1 and M_5 to the common node (highlighted in purple). The RF input signal current (red arrow) flows from capacitor C_2 to the same common node (purple). These currents combine and flow through M_7 toward ground (purple arrow). Ex.- 2024, ¶370.



In no case is there sampling of the RF input signal. Ex.-2024, ¶372.

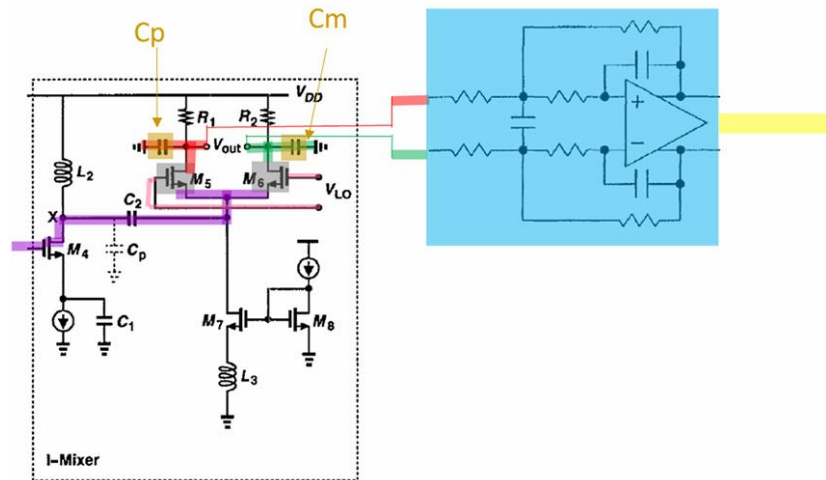
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opening and closing of M5 or M6, does not affect the RF input signal in any way.

Ex.-2024,¶373.

During his deposition, Dr. Galton attempted to distinguish between absolute or total current from VDD (which he agreed moves downwards) and “signal current” or “signal component.” Ex.-2034, 152:19-153:14, 165:21-167:12. This distinction is incorrect. There is only one physical current in the circuit—the absolute current from VDD. The “signal component” Dr. Galton refers to is not an independent current that flows separately but merely describes how the RF input signal affects the current flow from VDD. The entire current, including any signal variations, flows downward. No portion of the RF input signal current moves upward. Thus, no energy is transferred from the RF input signal as an output of M5 or M6. Ex.-2024,¶¶254-256;374-375.

2. **Razavi does not disclose/teach/suggest storing transferred energy from the modulated carrier signal or integrating/accumulating transferred energy from switches (claims 1 and 19).**



As shown above, Dr. Galton incorrectly alleges capacitor C_p/C_m store and accumulate/integrate portions of transferred energy from the RF input signal. Ex.- 1003, ¶¶233-235, 239, 243.

But no current—and therefore no energy—from the RF input signal passes through M_5 or M_6 towards the capacitors C_p/C_m . Section IX.C.1 Thus, no energy from the RF input signal can ever make its way to the capacitors to be stored and accumulated/integrated. Ex.-2024, ¶¶376-378.

3. **Razavi does not disclose/teach/suggest transferring energy from the modulated carrier signal to the storage element when the switch is ON (claims 8 and 26).**

According to Petitioner, Razavi's capacitors C_p/C_m function as the alleged storage elements. But in Razavi, capacitors C_p/C_m do not charge when M_5 or M_6

is ON. Rather, they would charge when M5 or M6 are OFF—the opposite of what the claims require. Ex.-2024,¶380.

Specifically, when M5 or M6 is ON, the respective capacitor is connected through to M7 and ultimately to ground, forming a discharge path. As discussed in Section IX.C.1,2 above, when the switch is ON, current only flows down through M5 or M6 and into M7. Conversely, when M5 or M6 is OFF, the capacitor is disconnected from the signal path to ground and only connected to VDD through R1 or R2. When either M5 or M6 is OFF, the respective capacitor is isolated from ground (via M7) and instead is connected only to VDD, allowing it to only charge from VDD. Ex.-2024,¶381.

Further, Razavi's capacitors do not receive any energy from the modulated carrier signal (RF input signal). The capacitors receive current/energy only from VDD. No current—and therefore no energy—flows from the RF input signal upward through M5 or M6 toward C_p or C_m . Section IX.C.1; Ex.-2024,¶¶382-383.

4. There is no motivation to combine Razavi-MacNally.

Petitioner contends that a POSITA would have found it obvious to incorporate Macnally's biquad two-pole filter in Razavi's receiver. Pet., 65; Ex.-1003,¶¶227-229. Not so. Ex.-2024,¶384.

First, Razavi does not simply identify a generic amplifier circuit or use a generic symbol for an op-amp. Instead, Razavi Figure 5 discloses a fully realized

amplifier design (including the length and width of transistors) tailored to meet specific performance goals: to achieve “high gain,” improve linearity, and reduce noise. Ex.-1017, 113. Petitioner inexplicably removes Razavi’s carefully designed amplifier and replaces it with Macnally’s filter. Ex.-2024, ¶385.

Second, Macnally’s biquad two-pole filter acts as a low-pass filters—anti-alias filter. Ex.-1021, 7:17-19; Ex.-1003, ¶143; Ex.-2034, 56:5-57:16. An anti-aliasing filter removes aliased signals from the band of operation. Razavi, however, already discloses on-chip RC low-pass filters. Ex.-1017, 113; Ex.-2024, ¶386.

Razavi makes no mention of the need for additional filtering or bandwidth narrowing beyond these RC filters at the mixer output. This is because Razavi’s architecture is already designed to handle high-frequency content and suppress out-of-band signals. A POSITA would recognize that the existing RC filters found in Razavi already perform the anti-aliasing function—Razavi’s RC filters serve the role of aliasing suppression. Thus, a POSITA would not be motivated to add another filtering stage such as Macnally’s filters at the output of the mixer. Ex.-2024, ¶387.

Dr. Galton asserts that because Razavi states “channel-selection filtering is not included,” this suggests the desire for channel-select filtering and need to turn to Macnally. Ex. 1003, ¶228. But Dr. Galton misrepresents what Razavi actually teaches. Ex.-1017, 113. In context, Razavi is simply clarifying that the on-chip

capacitors do not perform channel selection. This is not an admission that Razavi's receiver lacks channel filtering altogether. Ex.-2024,¶388.

Indeed, Razavi Figures 4(b) and 4(c) expressly show a channel-select filter block located *after* the amplifier of Figure 5. Thus, Razavi intentionally places the channel-select filter downstream of the amplifier—not within it like Macnally. Moreover, as discussed below, Razavi's architecture reflects deliberate staging, in which amplification and filtering are handled in separate circuit blocks. A POSITA would recognize that inserting Macnally's filter at the amplifier stage would contradict Razavi's specific design intent. Ex.-2024,¶389.

Third, according to Petitioner, Macnally's filter offers advantages such as cancelling interference, minimizing harmonic distortion, and improving linearity. Pet. 28. But Razavi already addresses these issues. Just like Macnally, Razavi's amplifier (Figure 5) uses differential inputs and differential outputs and operates on complementary signal components. Ex.-2024,¶390.

Further, Razavi also addresses noise, improving linearity, and distortion. Ex.-1017 (“In order to improve the linearity...”), (“The problem with noise differential [] is overcome by allowing...”), (“suppressing low-frequency beat signals that are generated if two input interferers experience [distortion]...”). Thus, a POSITA

would not be motivated to look for a solution to these issues. Accordingly, a POSITA would not think to look to Macnally's biquad two-pole filter. Ex.-2024, ¶391.

Finally, Macnally's biquad two-pole filter includes additional op-amps, resistors, and capacitors that significantly increase the component count over Razavi's amplifier. Using Macnally's filter would actually require many more components than using Razavi's amplifier. In particular, Petitioner proposes a one-for-one substitution of Razavi's amplifier with Macnally's filter, yet the latter requires more circuitry, not less. Ex.-2024, ¶392.

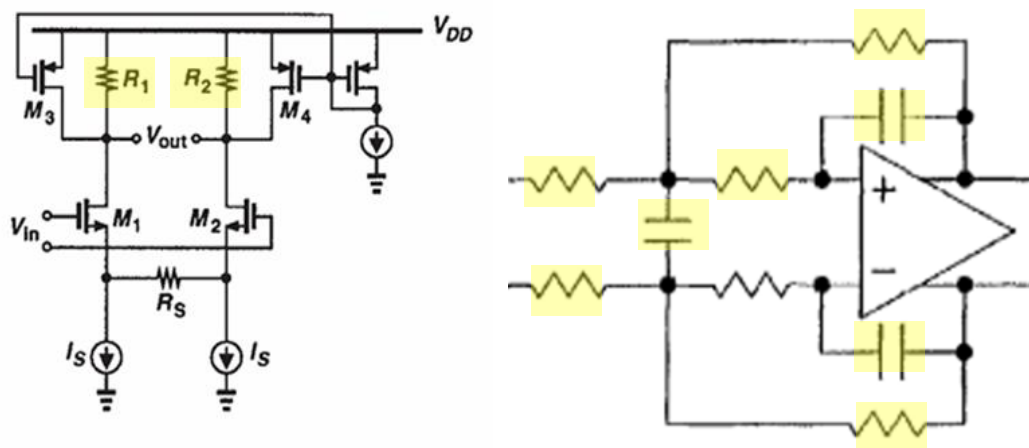


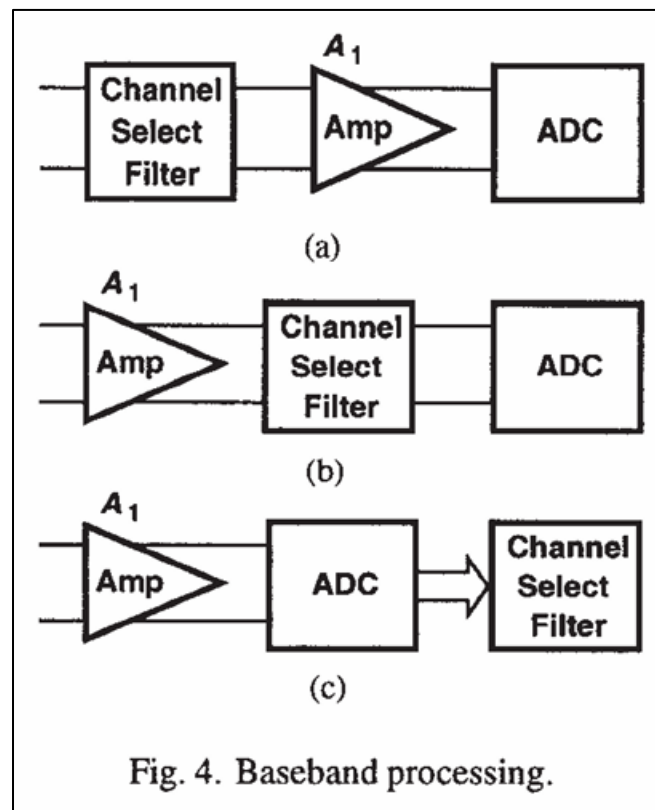
Fig. 5. Baseband amplifier.

As shown above, the highlighted components show the equivalent gain setting components. Razavi's amplifier (above left) has significantly fewer components than Macnally's biquad two-pole filter (above right). Thus, Petitioner's substitution would increase die area, power consumption, and circuit complexity. Ex.-2024, ¶393.

A POSITA seeking Razavi's stated objective of a "single-chip receiver"—and concerned with IC design factors like area, simplicity, and power—as Dr. Galton claims (*see* Ex. 1003, ¶228; *see also id.*, ¶144) would prefer Razavi's amplifier because it is already an integrated circuit and Razavi teaches this specific amplifier configuration as its design solution. There is no reason a POSITA would replace Razavi's amplifier with Macnally's biquad two-pole filter, especially when the claimed benefits (linearity, noise, filtering) are already addressed. Thus, a POSITA would not be motivated to use Macnally's filter to reduce the number of components or op-amps. Ex.-2024, ¶¶394-395.

a. Razavi teaches away from the proposed combination.

Razavi expressly teaches against the very design Petitioner relies on. Razavi explicitly discourages the use of channel select filtering—such as that performed by Macnally's biquad two-pole filter—after the mixer in its receiver architecture. Ex.-2024, ¶¶396-398.



In particular, Figure 4 illustrates three permutations of a baseband processing for the circuit following the mixer. Each permutation includes a channel select filter, baseband amplifier A_1 and analog-to-digital converter (ADC). Ex.-2024, ¶¶399-400.

Petitioner's proposed combination aligns with the permutation in Figure 4(a). Pet., 66-67. But Razavi specifically teaches against the use of the permutation depicted in Figure 4(a). Ex.-1017, 113. Razavi criticizes (and teaches away from) this permutation because "the low-pass filter design entails severe noise-linearity-power tradeoffs." *Id.* Indeed, Razavi specifies that "[t]he present design is intended for permutations in Figs. 4(b) and (c)." *Id.*; see also Ex.-2024, ¶¶401-403.

b. Razavi-Macnally are not compatible.

Razavi and Macnally are fundamentally incompatible. Ex.-2024,¶404.

The outputs of Razavi's mixer—Vout—are connected directly to the gates of NMOS transistors M1/M2 in Razavi's amplifier (Figure 5). Section VIII.C. Razavi's amplifier operates as a *high impedance* load, which is critical to ensuring accurate baseband voltage representation. Ex.-2024,¶405.

Petitioner, however, propose replacing Razavi's high impedance amplifier with Macnally's filter. According to Petitioner, Macnally's filter presents a *low impedance* load. See Pet. 35, 70, 72; Ex.-1003 ¶240. A POSITA would understand that substituting a low impedance load in place of a high impedance load would alter the operation of Razavi's circuit. In particular, a low impedance load would draw current, compromising the baseband signal accuracy. Ex.-2024,¶406.

This is not a minor/superficial difference. High and low impedance loads produce materially different effects in analog circuits. In Razavi's circuit, a high impedance amplifier is essential to preserving the voltage signal developed at the output of the mixer. Moreover, Razavi specifically states, "to achieve a high conversion gain...R1 and R2 must be maximized." A low impedance load, like Macnally's filter, would distort this signal. Replacing Razavi's amplifier with a low impedance circuit would not simply modify the circuit—it would defeat its intended design goals. Ex.-2024,¶407.

The incompatibility between Razavi's high impedance amplifier and Macnally's low impedance biquad filter would therefore dissuade, not encourage, a POSITA from making Petitioner's proposed substitution. Ex.-2024, ¶408.

c. There is no reasonable expectation of success in combining Razavi-Macnally.

Petitioner asserts that replacing Razavi's amplifier with Macnally's biquad two-pole filter "would have had a reasonable expectation of success." Pet., 66-67; Ex.-1003, ¶229. Not so. Ex.-2024, ¶409.

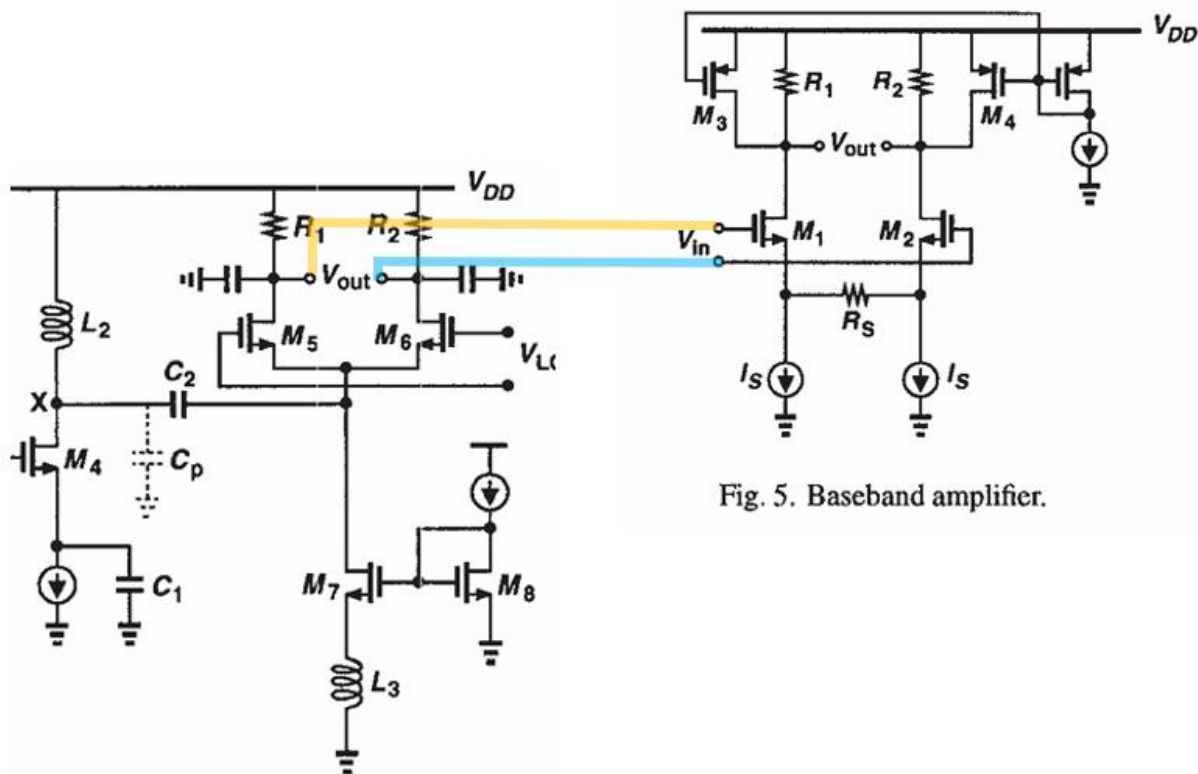
Replacing Razavi's amplifier with Macnally's filter requires fundamental restructuring of Razavi's receiver architecture. Ex.-2024, ¶¶410.

First, Razavi explicitly criticizes what Petitioner proposes which is the design permutation shown in Figure 4(a). Ex.-1017, 113; Section IX.C.4.a. A POSITA would not ignore Razavi's express warning and adopt the very design Razavi cautions against. Ex.-2024, ¶411.

Adding Macnally's Rauch biquad two-pole filter into Razavi's system would also require considerable experimentation to figure out how to design Razavi with a complicated circuit – a Rauch biquad two-pole filter. There is no guarantee that the newly designed circuit would have any advantages for on-chip performance compared to using Razavi's amplifier. Using Macnally's filter, which includes a lot

of components, would not lead to predictable results or a reasonable expectation of success. Ex.-2024, ¶412.

Second, replacing Razavi's amplifier with Macnally's biquad two-pole filter would alter the fundamental operation of Razavi's circuit. Ex.-2024, ¶413.



I-Mixer

Fig. 5. Baseband amplifier.

Razavi's mixer outputs (V_{out}) connect directly to the gates of NMOS FETs M1 and M2 (Figure 5). This is a voltage-mode design that depends on using a high impedance load—Razavi's amplifier. Section VIII.C. According to Petitioner, Macnally's filter provides *low impedance load*. Pet., 35, 70, 72; Ex.-1003, ¶240.

High and low impedance loads have very different effects on a circuit. Sections III.B.5, IV.B, VI.B.2, Razavi specifically states, “to achieve a high conversion gain...R1 and R2 must be maximized.” Moreover, a low impedance load in Razavi would lead to an inaccurate measurement of the voltage and Razavi would not be able to accurately reproduce the baseband signal. Specifically, the low impedance would draw current away from the mixer output, disrupting the voltage levels intended to represent the baseband signal. Ex.-2024,¶414.

Using Macnally's filter would ignore all of the disclosure in Razavi, abandon all of the teachings and suggestions of Razavi, and fundamentally change the Razavi's circuit. Ex.-2024,¶415.

D. None of the prior art references teach/disclose/suggest an energy transfer system.

Claim 1 recites a first and second “energy storage element.” See Section VII.C. Neither Tayloe nor Razavi disclose/teach/ suggest an energy transfer system. Ex.-2024,¶416.

Tayloe is a voltage sampling system. Section VIII.A. Razavi does not perform sampling, and does not accumulate/discharge transferred energy from the input signal to a load. Section VIII.C. Ex.-2024,¶417.

Moreover, by using an active mixer with high gain, Razavi is not transferring the RF input signal or its energy to the output of the mixer. See Section VIII.C; Ex.-2024, ¶418.

Dated: April 4, 2025

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that this Patent Owner's Response complies with the type-volume limitation of 37 C.F.R. § 42.24(b) because it contains 13,955 words, as determined by the word-processing program used to prepare the brief, excluding the parts of the brief exempted by 37 C.F.R. § 42.24(a)(1).

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CERTIFICATE OF SERVICE

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