The History of Articulators: The Contributions of Rudolph L. Hanau and his Company—Part I

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Abstract

This article is a historical review of the last decade of Rudolph Hanau's life. It covers his introduction to dentistry and explores his prolific articulator designs and contributions to the prosthodontic literature.

Few names in dentistry have been associated with articulator design and manufacture as much as that of Hanau. Indeed, over the past 85 years, many have considered the name Hanau to be synonymous with the word articulator.[1,2] Rudolph L. Hanau (Fig 1)[3] was born in Victoria West, Cape Colony, South Africa in 1881. He was trained as a mechanical engineer in Leipzig, Germany. By 1906, he had immigrated to the United States where he worked as a consulting engineer in New York City.[2]

Dr. Frederick Lester Stanton, a New York City orthodontist, conferred with Hanau in 1915 to assist in devising a practical method to determine dental arch form. Their association led to the development of the Stanton-Hanau Surveyor (Fig 2).[1,2,4] This instrument was intended for orthodontic research and was never meant to map the contours of teeth. No evidence has been found to suggest that this surveyor was ever sold commercially.[2,5,6] Hanau left New York City in 1917 to live in Pittsburgh, PA. He again relocated in 1918 to Buffalo, NY.

In 1920, the legendary Rupert E. Hall consulted with Hanau concerning a new articulator design. This challenge set the course for the remainder of Hanau's professional career. Hall's intent was to develop an adjustable three-dimensional instrument with a central vertical axis, around which the condyles orbited during function (Fig 3).[7] He wanted Hanau to build the prototype. In the end, Hanau chose to follow the conventional approaches of the time. His concept and resulting landmark Model H evolved from the designs of Gritman, Gysi, Snow, and Wadsworth.[1,2]

Hall's consultation with Hanau may have ignited the engineer's passion for articulator design; however, Hanau's epiphany came during one of the heated battles of the early 20th century "Articulator Wars." In 1920, Hall invited Hanau to attend the Boston meeting of the National Society of Denture Prosthetists. Many of dentistry's "Titans" of the day were in attendance. Hanau was exposed to the likes of Drs. Alfred Gysi, George S. Monson, and his host, Rupert E. Hall. Each presented papers on his personal theory of mandibular movement and articulator design. As an engineer, Hanau perceived the problem of articulation quite contrary to what he heard at the meeting.

Upon returning from Boston, Hanau launched the full effort of his engineering department to design and develop a prototype articulator. In just a few months, he had produced his Model A articulator. He applied for a US patent in February 1921 (Fig 4).[8] Within another month he improved his design, which became the Model B articulator (Fig 5). The Model C was Hanau's final refinement in this series of instruments. He revealed it at the Milwaukee meeting of the National Society of Denture Prosthetists in August 1921. The Model C was commercially produced under the Model A patent, which was eventually granted on June 1, 1926.[2,8]

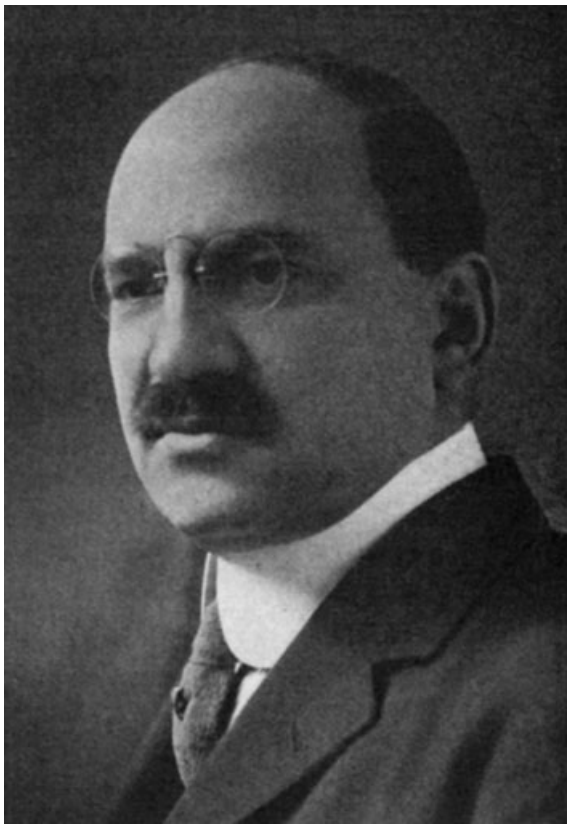

Figure 1 Rudolph L. Hanau (1881–1930) began designing articulators in 1920.

At the Milwaukee meeting Hanau posed the question, "Shall we adjust an articulator to conform to the anatomical ... requirements (of the patient), or may we expect our patients to fit an average articulator?"[2,9] Hanau did not agree with the "Geometric" theories of mandibular movement as proposed by Hall, Monson, and others. Rather, he firmly believed that an articulator should be programmed by means of records generated by the patient.[9] Hanau's theory was generally accepted by the profession, but his Model C was not, and was considered complicated and impractical to use.[2,10]

Hanau realized he had missed his mark in designing an instrument that could be programmed with protrusive and lateral check bites. In July 1922, he presented another paper at the National Society of Denture Prosthetists' Los Angeles meeting.[11] He theorized from an engineering standpoint that with the Model C, there would still be occlusal discrepancies; however, he assured the group that they could be easily corrected with remounts of the mandibular denture. Drs. Russell W. Tench, Rupert E. Hall, and members of the Buffalo Study Club of Dental Engineering all were critical of Hanau and his Model C. Undaunted, Hanau was already heading in an entirely different direction. By May 1922, he had finalized plans for his benchmark Model H (Fig 6), originally referred to as the Delta Sigma.[2] The Model H and the brief period required for its design established Hanau's genius in this area. The Model H was precisely made, strong, and easy to use. Most importantly, the controls were set according the patient's anatomy. Patent application for the Model H was made on February 3, 1923. This patent was finally granted on July 8, 1928 (Fig 7).[12] In addition to the development of the Model H, Hanau wrote his revised technique for making the intraoral records necessary to program this instrument.[13] The Model H enjoyed incredible popularity. Among its proponents were many of the "Giants" of that era: Drs. Stanley D. Tylman,[2] A. E. Boyce,[14] Robert R. Gillis,[15] Robert N. Harper,[16] and R. O. Schlosser.[17,18] The Model H was manufactured for 40 years. Many of its design features have been incorporated into instruments manufactured in the 21st century.

According to Richard Beu's "Chronicles of Hanau Products,"[2] Hanau's Engineering Department was constantly exploring new ideas and directions. Concepts leading to the development of the Model H were on the drawing board at the same time the Model C was being introduced to the profession. When Hanau was on the road, he kept in close contact with Edmond J. Franwich, his dedicated assistant at the factory. Hanau frequently called him and mailed sketches on hotel stationery.[2] Franwich well understood Hanau's thought process, impulsiveness, and passion.

One very interesting early factory research prototype was a downgraded Model H meant for "crown and bridge" work. It was designated the Model "K" (Fig 8).[19] Unique to this articulator was its fixed incisal guide pin and vertically adjustable incisal guide table. The incisal guide table was set at an angle to the lower member of this instrument. The Model K proved too expensive to put into production and was not able to compete with the already successful Model H.

The Hanau Kinoscope was developed during the same period as the Model H. The original intent for this instrument was to be a research and demonstration tool. This articulator had an adjustable intercondylar distance and Bennett Angle control. It accepted both lateral and protrusive records in keeping with Hanau's premise that articulators should be programmed according to the patient's anatomy and that denture patients should not be forced to adjust to an occlusion developed on an average value instrument. The Kinoscope also provided a platform for the evaluation of Hanau's incisal guide table and pin prototypes.

In June 1923, the Hanau Engineering Company marketed the first generation of the Kinoscope.[19] It was originally dubbed the "Special Orthodontic Machine," but very soon that was changed to the Kinoscope Model M (Fig 9). The Kinoscope Model A-2 made its brief appearance in 1926 (Fig 10) and was replaced by the Kinoscope Model C in 1928. That same year, the incisal guide table was replaced by the adjustable Hanau Universal Guide Table (Figs 11 and 12), which became a standard feature for the duration of the Kinoscope's production run. A centric latch was added in 1937. The Kinoscope's popularity actually peaked in the late 1920s.[20] In their sales literature, Hanau Engineering Company boasted that with the Kinoscope, "Guess work or empirical methods no longer need prevail in investigations of mandibular functions in denture prosthesis, orthodontic, or periodontic work."[21] Russell W. Tench, a very strong advocate of the Kinoscope Model M read a paper before the American Dental Association's September 1925 Louisville, KY meeting. He stated that, "For two years, or about that length

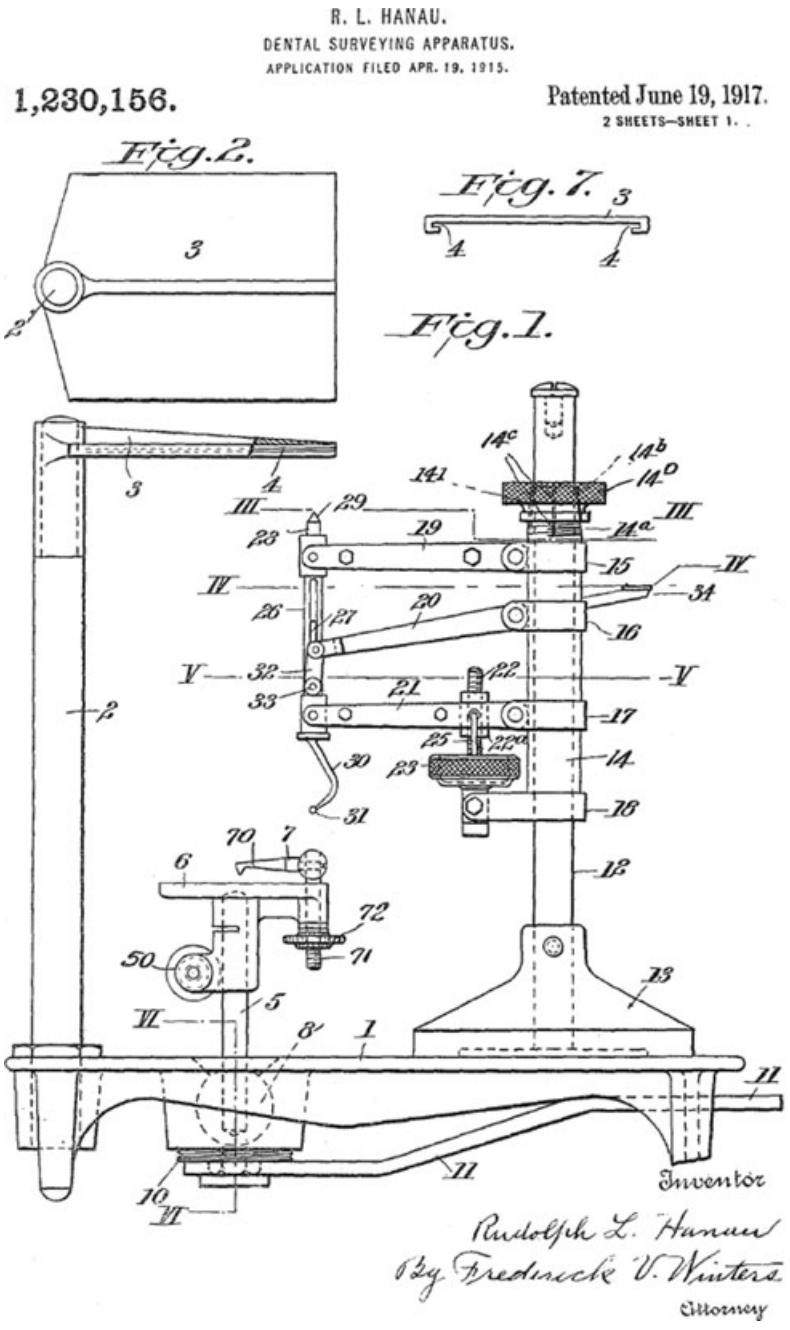

Figure 2 The Stanton—Hanau surveyor of 1917 was Hanau's first dental patent.

of time, we have had in the Hanau Kinoscope an almost perfect instrument . . . It is the only instrument available to the profession at the time in which the mandibular movements can be fully recorded by interocclusal impressions."[22]

There were a number of research prototypes for the Kinoscope throughout the course of its production. A few of them have survived in the Hanau Factory collection (Fig 13). Despite continuous research and development of three-dimensional instruments, the factory never replaced the Kinoscope Model C. It remained in production until 1964.[20]

Considering the level of sophistication Hanau achieved with the Kinoscope and the amount of professional interest it garnered, the question must be asked, "Why did Hanau Engineering choose to make its mark with the Model H and never offer any of the advanced prototypes that followed the Kinoscope Model C?" Besides his engineering expertise, Hanau was an accomplished businessman. He was aware that the Gysi Adaptable articulator of 1912 was not accepted by the profession because it was too complex and costly. Only about 100 of those instruments were ever made. Professor Gysi's response was to design his Simplex articulator, which was successfully manufactured in one form or another for about 60 years. Hanau also saw his own original Model A, B, and C articulators fail in the marketplace. The Model H gave the profession what it

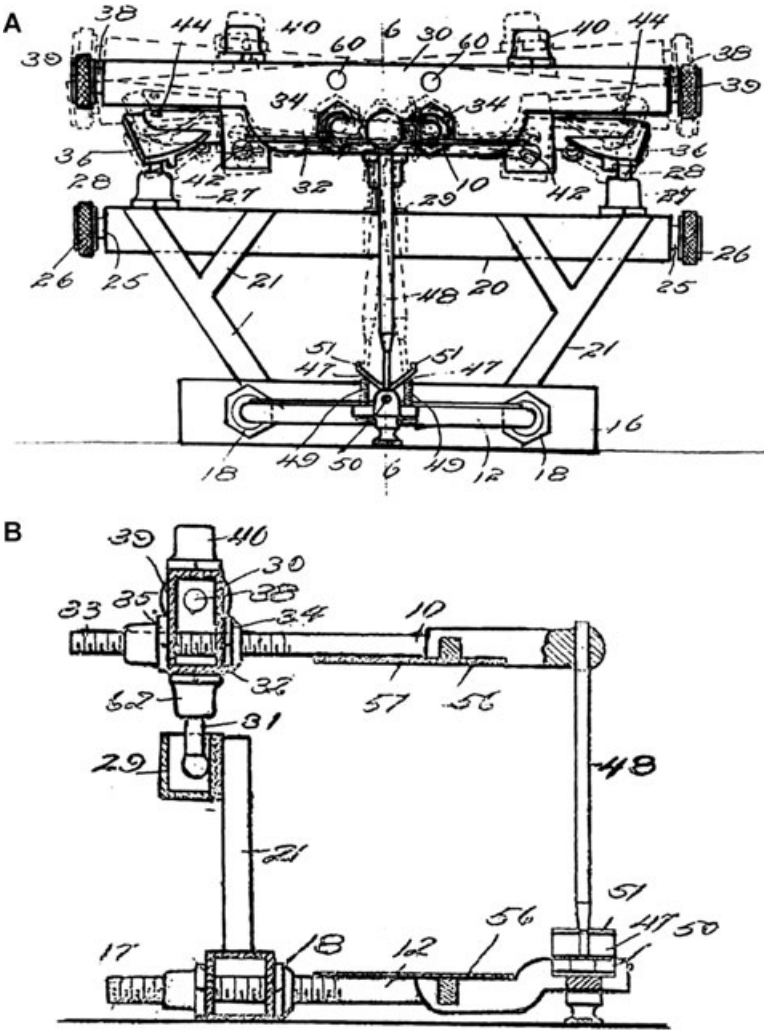

Figure 3 Hall presented drawings of his "dental occluding frame" to Hanau in 1920. This instrument was based on Hall's geometric theory of mandibular movement, and it received a US Patent in 1917. There is no evidence that Hanau ever built a prototype of this articulator.

wanted. But, what of Hanau's standard of programming articulator controls according to the dictates of a patient's anatomy? The Model H could not accept lateral check bites due to its lack of an adjustable intercondylar distance and the confines of its straight condylar guides. Hanau solved this dilemma with two classic proposals that enabled him to promote the Model H without seeming to compromise his exacting standards. Though to some these ideas may have appeared as "sleight of hand."

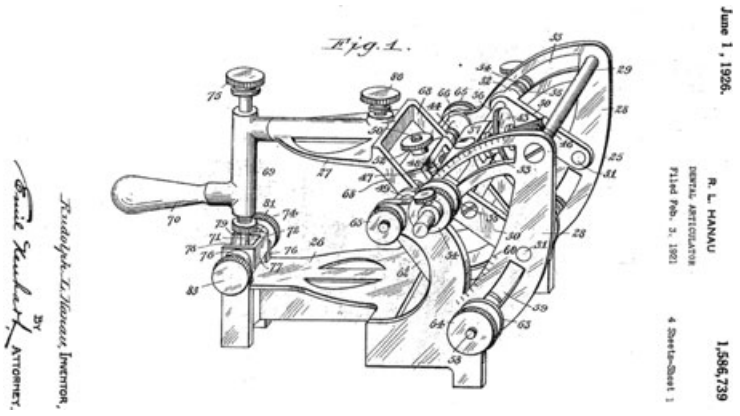

Figure 4 Hanau's Model A articulator was designed in 1921 but did not receive a US patent until June 1, 1926.

Figure 5 Hanau's Model B articulator was also developed in 1921. (courtesy collection of the University of Texas Houston Health Science Center —Dental Branch).

Figure 6 The Model H was manufactured for 40 years. Many of its features can be found on articulators currently produced. (courtesy Teledyne-Hanau factory collection).

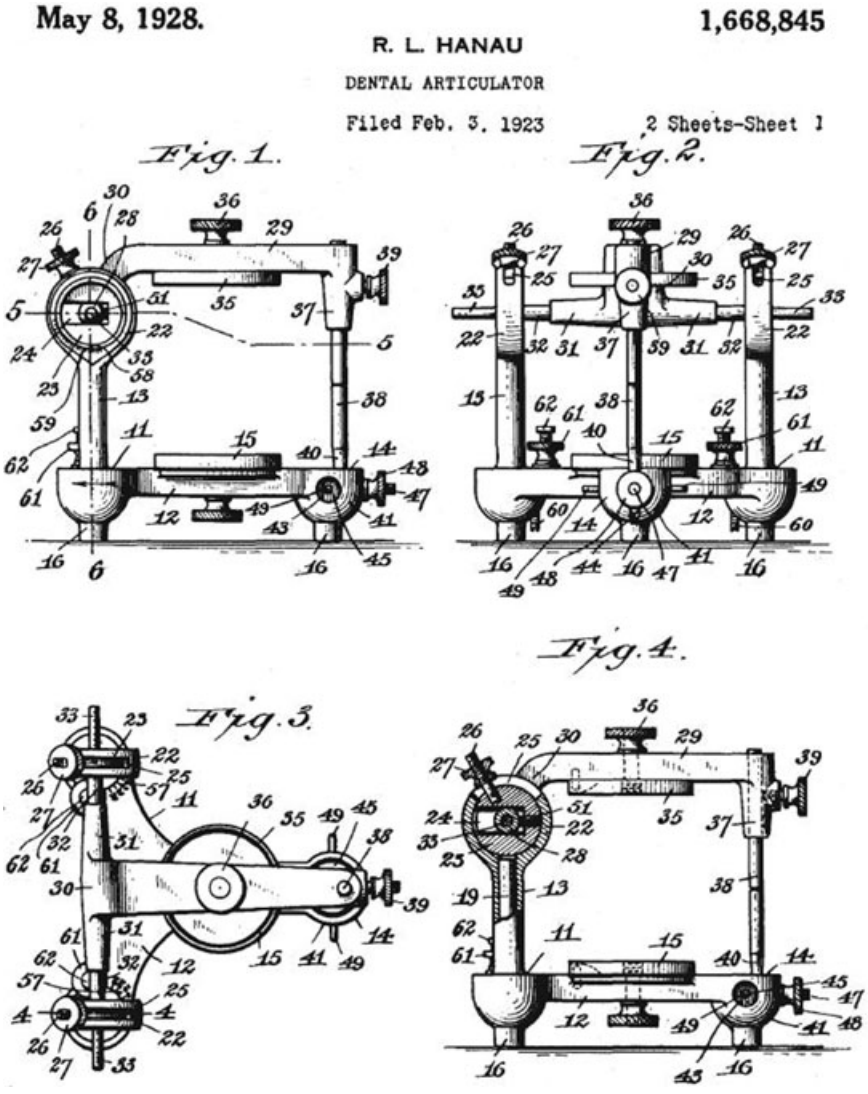

Figure 7 A US Patent was granted for the Model H on May 8, 1928.

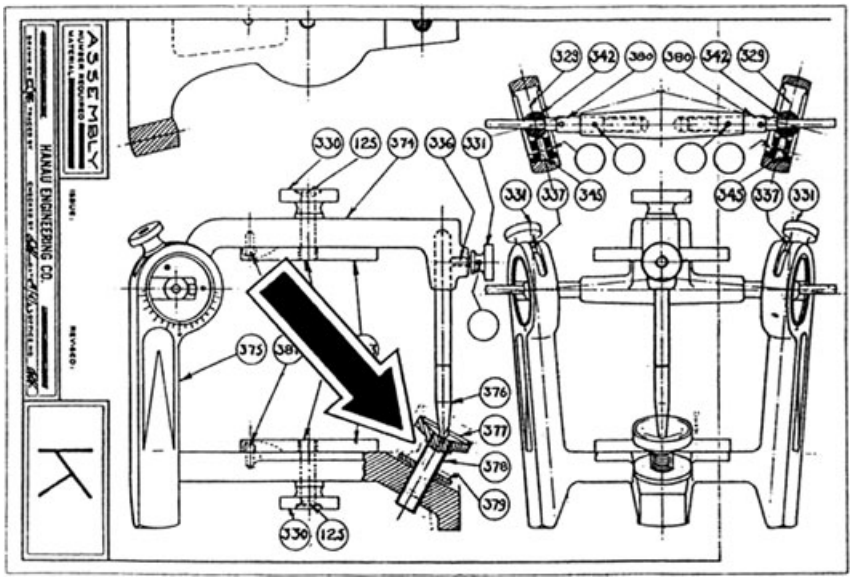

Figure 8 The Model K was an early factory prototype intended for crown and bridge work. It was too expensive to compete with the already popular Model H and so was never put into production.

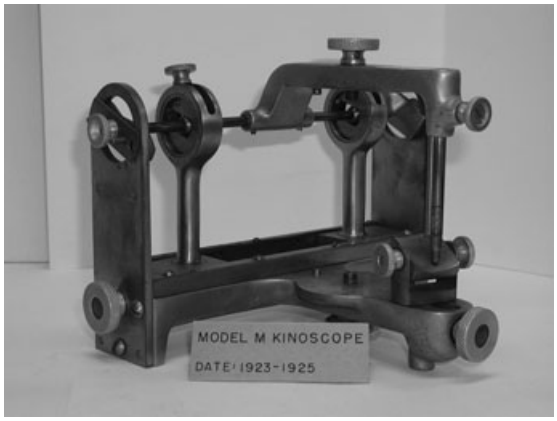

Figure 9 The Model M Kinoscope of 1923 had an early vintage incisal guide table and wide but thin outside posts. (courtesy Teledyne-Hanau factory collection).

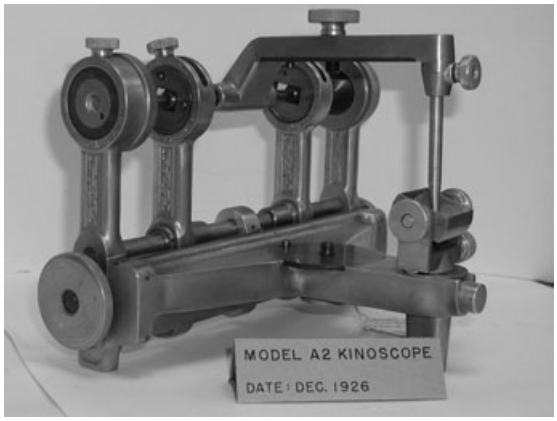

Figure 10 The model A-2 Kinoscope of 1926 had die cast outer posts similar to its inner posts; however, it still had the same early incisal guide table as the Model M. (courtesy Teledyne-Hanau factory collection).

First was the development of the famous, if not incomprehensible, "Hanau Formula" that appeared on the underside of the Model H lower member

$$L \text{ (lateral adjustment)} = H(\text{horizontal adjustment})/8 + 12.$$

According to Beu:[2] In 1960, Jack Stern, Hanau's long-term partner, confided that after 10 years of research (1920–1930), Hanau concluded there was a definite relationship between the inclinations of the horizontal and lateral control settings. He found the lateral settings to consistently range around 15°. Stern insisted that the "Formula" was never considered to be exact. Rather, it was an approximate or starting point. Hanau believed more accurate records could be made once all the teeth were set. He further proposed that remounts and equilibrations were necessary to refine the occlusion. The engineer did not want to tell the profession to simply set the lateral controls at 15°. That would suggest a step backwards to an average value instrument. "Hence, Hanau developed the 'Formula' as a security blanket"[2] (Fig 14).

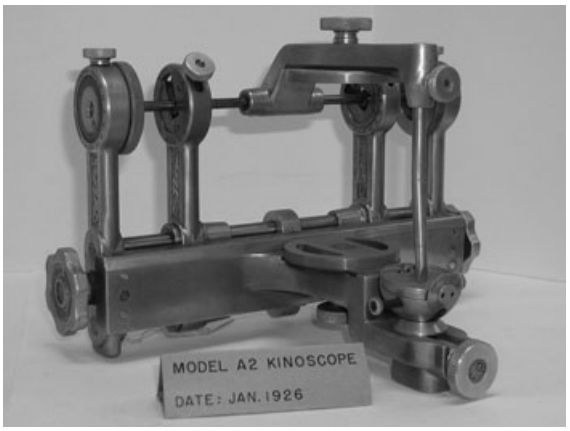

Figure 11 The Model C was Hanau's final production version of the Kinoscope. (courtesy Teledyne-Hanau factory collection).

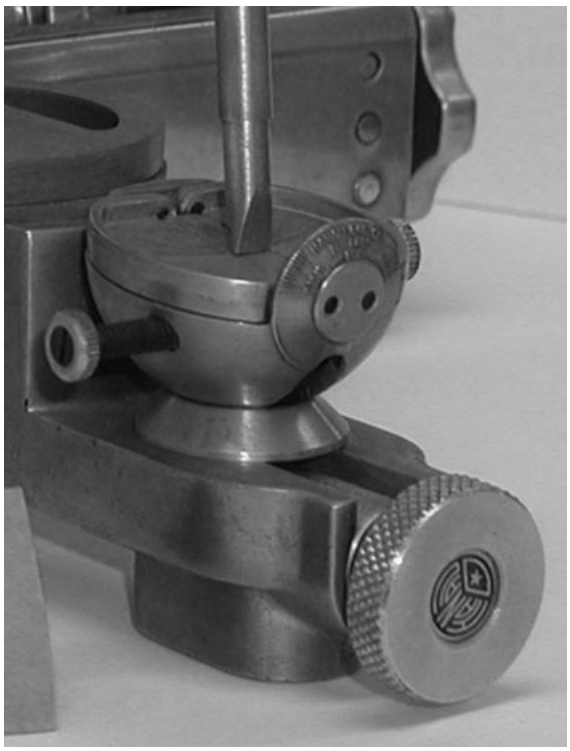

Figure 12 The Hanau Universal guide table was added to the Model C Kinoscope in 1928 and remained unchanged until Kinoscope production ceased in 1964. (courtesy Teledyne-Hanau factory collection).

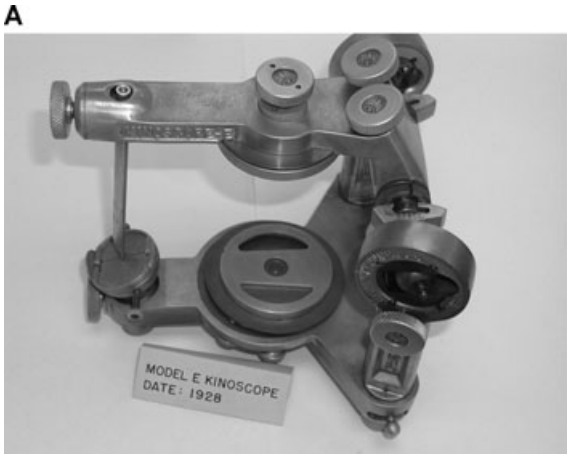

Figure 13 (A), (B), and (C): Illustrated are three examples of Kinoscope prototypes that followed the Model C but which were never produced commercially. Note the occlusal grinder incorporated into the lower member of the Model E shown in (A). (courtesy Teledyne-Hanau factory collection). (C): Example of Kinoscope prototype following Model C, but never produced commercially. (D): An unidentified Hanau prototype. Though the factory could not provide any information on this model, the authors have verified that at least two of these instruments exist. (courtesy collection of Dr. Donald M. Belles).

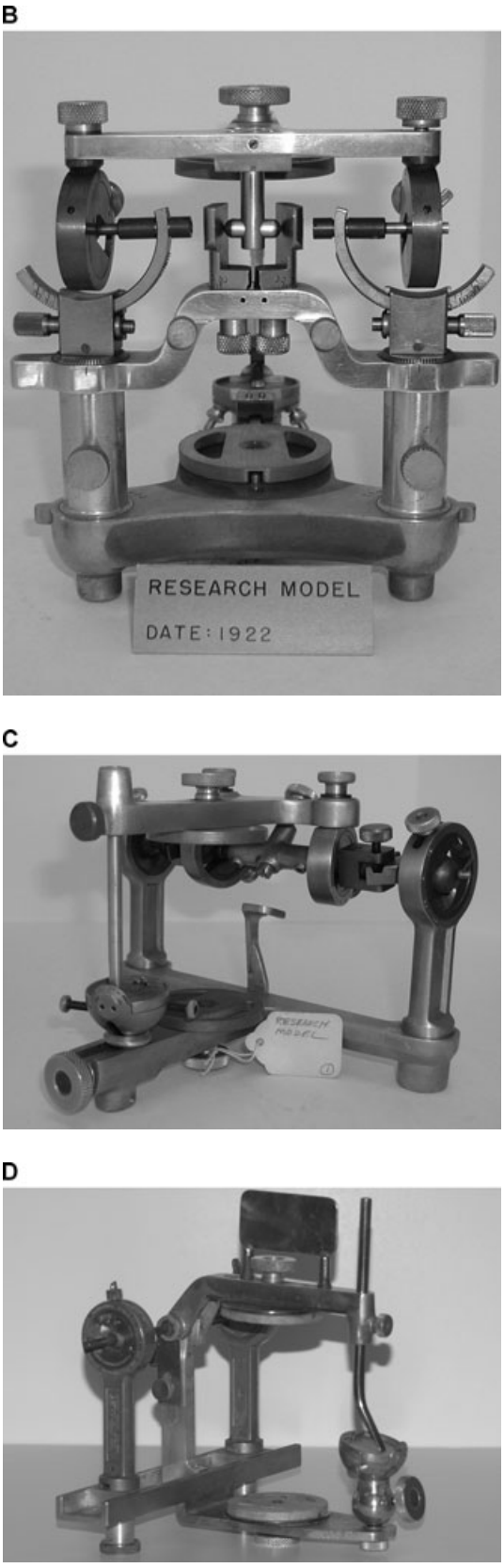

Figure 13 continued

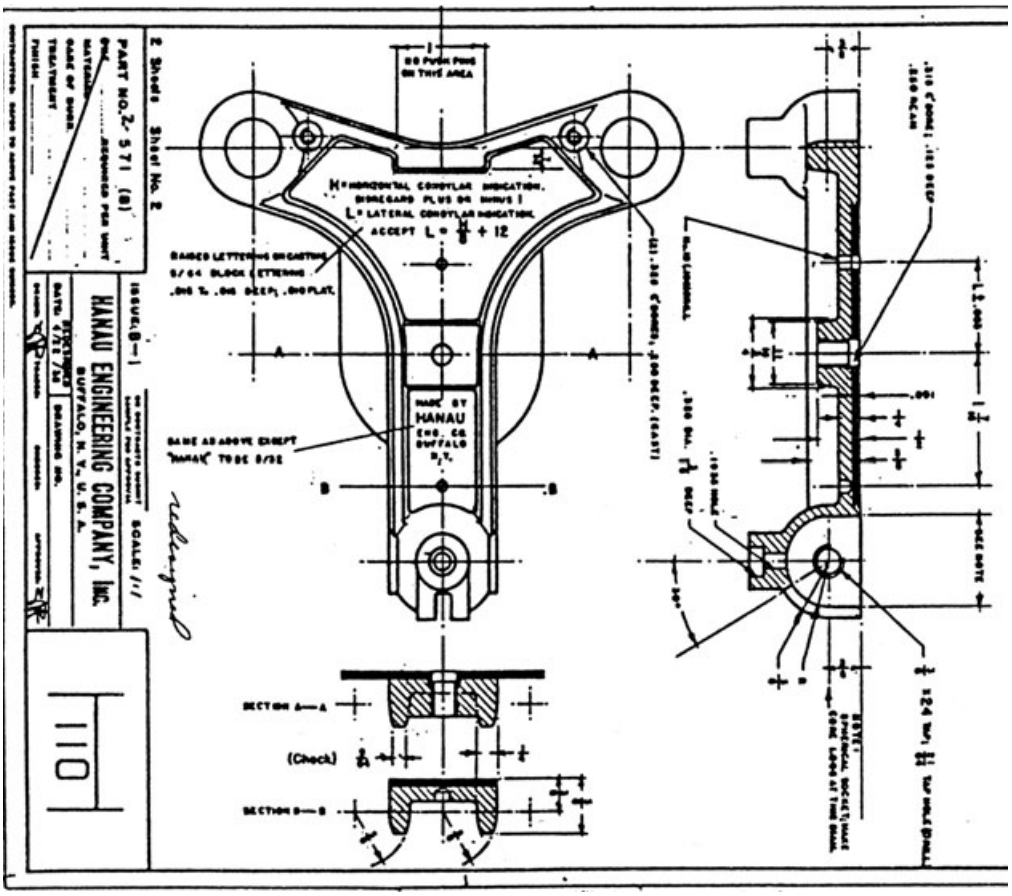

Figure 14 A Hanau Engineering factory drawing of the die cast lower member of the Model H articulator. Hanau's "Formula" was clearly recorded in the casting.

The second proposal was Hanau's theory of "Resilient and Like Effect or Realeff," which was a cornerstone in his philosophy of complete denture occlusion.[2,23,24] This concept appeared in his writings of the late 1920s. He perceived the denture-bearing area to be a resilient anatomical apparatus. This included mucosa of varying thickness, firmness, mobility, and state of health. He even considered the salivary film in his theory. Hanau understood that all dentures moved both right and left as well as anteriorly and posteriorly. In addition, he appreciated that they also moved vertically and compressed the supporting tissues. Unfortunately, there was no way to quantify "Realeff" when programming the instrument.

Because of the phenomenon of "Realeff," the engineer postulated that a precise balanced occlusion developed on an articulator would not be present in the patient's mouth. It had to be refined through clinical remounts to balance intraorally. He firmly asserted that the anatomic angle of the eminence could only be the same as that of a programmed instrument if "Realeff" was absent.[24]

Hanau claimed in his publications that the Model H was not designed to be an anatomic articulator, "as interpreted in the dental literature."[24] His intention was to provide a tool capable of producing the equivalent movements of those of the mandible to the maxilla (a mechanism to enable clinicians to achieve an intraoral, balanced occlusion). His premise was that even the most precise anatomic records were actually not very accurate due to "Realeff." He still insisted, however, that a decrease in the accuracy of jaw relation records contributed to an increase in the "Resilient and Like Effect."[24]

Many of the dental pioneers who studied mandibular movement at the time believed that a geometric reproduction of the direction of the condylar guidance was essential for an articulator. Hanau emphatically disagreed, and he argued this point as early as 1921. He held that whatever starting points were chosen for mandibular movement, they had to allow for duplication of the movement. It did not matter that they did not coincide mathematically or geometrically. He emphasized that deviation from this duplicity of movement only increased the "Realeff."[24]

Hanau wrote his last paper just before his death in 1930. He was to present it at the Chicago Dental Society's Mid-Winter Meeting in 1931. Instead, the paper was read by Dr. Walter L. Wright of Pittsburgh, whom Hanau briefed just before his passing.[3]

From 1920 until his untimely end at age 49, Hanau designed a significant number of dental articulators. During that decade, he was also a prolific contributor to the dental literature. His

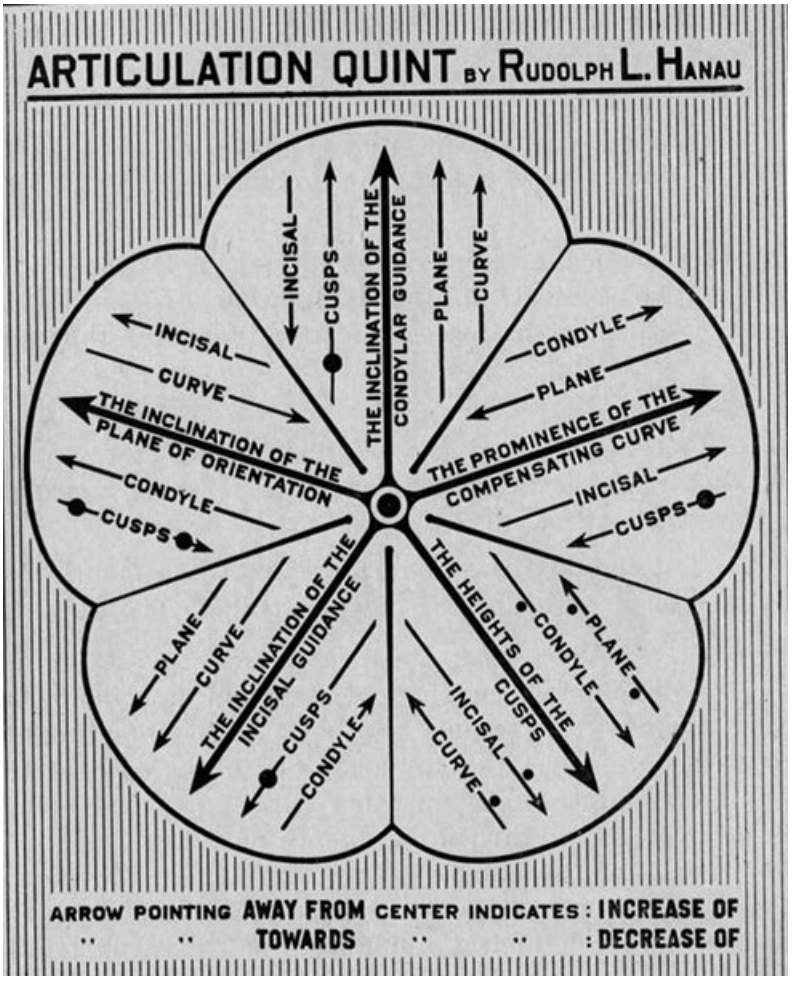

Figure 15 Hanau's "Quint" graphically illustrated the interaction of his "Laws of Articulation."

famous "Quint" (Fig 15),[24] Complete Denture Technique,[13] and concept of "Realeff"[23,24] have all found their way into the classical complete denture literature. This mechanical engineer was an active participant in many prestigious prosthodontic academy meetings of the day. He passionately believed in the use of the facebow, the importance of the centric relation record, and in programming instrument controls by means of precise patient-generated records. Finally, Hanau was a disciple of the School of Balanced Anatomic Occlusion. His papers have revealed that he was "hands on" in his research. He recorded jaw relations, set denture teeth, and remounted and adjusted processed dentures. His well-made Model H enjoyed extraordinary popularity and was favored by many dental schools across the country.

After Hanau's death in 1930, the Hanau Engineering Company was managed by Rudolph Hanau's partner, Jacob L. Stern. The American Optical Company purchased the company in 1958 when Mr. Stern retired. That was the same year the renowned Model H-2 was unveiled. Three years later, in 1961, William Getz purchased Hanau Engineering. In 1966, Mr. Getz exchanged his William Getz Corporation for stock in Teledyne, Incorporated. Hanau Engineering has survived as a division of Teledyne ever since.

Acknowledgments

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