The Austrian Pfleumer Invented and Introduced Magnetic Tape

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THIELE, Heinz H.;
Krögers Kamp, Schwarzenbek, Germany

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THE AUSTRIAN PFLEUMER INVENTED AND INTRODUCED THE MAGNETIC TAPE

Heinz H. K. Thiele
Krögers Kamp 1, D 2053 Schwarzenbek, Germany

ABSTRACT

The preservation and restauration of tape recordings presupposes the existence of magnetic tape - that goes without saying. Here in Vienna more than anywhere, it seems important to report upon the life and activities of a man who, in 1928, not only invented the magnetic tape but, in contrast to inventors before him, succeeded in realizing his idea and putting it to practical use: the Austrian engineer Pfleumer.

INTRODUCTION

Signs are posted in the carriages of the Hamburg City Railway instructing Walkman fans to moderate the volume of their equipment, a sign of the popularity of these ingenious small devices, which any child can operate. Here, as everywhere in the world, the magnetic tape device has become both a consumer good and a professional instrument. Countless video recorders and camcorders are recording sights and sounds around the clock. All these recorders and, in addition, many other information storage devices, for example from the computer field, contain information carriers, comprising base material coated with a magnetizable layer. The development, production and sales of these information carriers and of the associated equipment are increasing all the time.

Here are just two statistics: in 1990, about 2,570 million compact cassettes were sold worldwide, of which about 970 million were prerecorded music cassettes (1);

about 2,000 million video cassettes were sold, of which about 700 million were prerecorded cassettes (2).

Altogether, these products, especially with the associated equipment, represent a considerable commercial potential.

The name of the initiator of this technology is Fritz Pfleumer. He was granted two German patents which came into force on January 31, 1928: DRP 500 900 "Lautschriftträger" (Sound-recording carrier) and DRP 544 302 "Verfahren zur Herstellung von Stahlpulver" (Process for producing steel powder). Claim 1 of DRP 500 900 protects sound-recording carriers having a finely distributed paramagnetic material on a non-magnetic substrate, wherein "the paramagnetic powder is a powder having paramagnetic properties, steel, hydrogenous iron or the like, which is applied in an even layer thickness over the entire surface of the substrate". (3) (4)

Before the invention and introduction of the magnetic tape, magnetic information carriers were of steel in wire or tape form. The magnetic sound recording technique had been invented by the American Oberlin Smith in 1878 and reported on for the first time on September 8, 1888 in the US journal "THE ELECTRICAL WORLD". (5) The first working devices date back to 1899 and were constructed by Valdemar Poulsen. The demonstration of the "Telegraphon", as Poulsen called his magnetic sound recording apparatus, at the Paris World Exhibition in 1900 was a sensation. Even Franz Joseph, Emperor of Austria, recorded his voice on a steel wire for posterity when he visited Paris.

At first, practical application of the invention did not come up to expectations, primarily due to the absence of suitable means for signal processing. Only after about 1920, when amplifiers came into use, based on the electron tube invented by the Viennese inventor Robert von Lieben, were various usable magnetic sound recording devices produced. They were principally for dictating purposes, for recording telephone conversations etc.

The "Steel Age" reached its height when machines which were also suitable for recording music were introduced by Marconi/Stille, London, a number of which were used from about 1934 at the BBC, and with the steel tape sound recording machines produced by C. Lorenz AG, Berlin. These were used at the Reichsrundfunk Gesellschaft (Imperial Broadcasting Company), Berlin, and in Swiss radio studios in the mid-thirties, until magnetic-tape apparatuses came on the scene.

For dictating purposes, in 1929 the Berlin company F. Schuchhard AG produced the dictating device "Dailygraph", in which the steel wire serving as information carrier was for the first time housed in a cassette in order to simplify operation. The successor of this model, which C. Lorenz AG called the "Textophon" was manufactured up until the end of the war and, apart from special cases, was the last steel wire apparatus on the market. (6)

Now to Fritz Pfleumer. At the end of the last century, his father owned a bookprinting works in Salzburg. Nothing is known of his son's activities until he moved away from Salzburg in 1897. In Dresden, where he lived until his death in 1945, the engineer was involved in various areas which at first had nothing to do with magnetic storage: for example, he is the inventor of foam rubber and drinking straws made of paper. He occupied himself with applications of paper for some considerable time.

The result of one of his projects in this area was paper with a durable coating of bronze lacquer, suitable for the production of cigarette tips as a substitute for the gold leaf occasionally used on deluxe products. He worked as a consultant in this area for the Dresden cigarette machine factory "Universal". (7) (8) (9)

END OF THE STEEL AGE - DAWNING OF THE MAGNETIC TAPE ERA

Since he was seventeen, Pfleumer had an active interest in magnetic sound recording. (10) Today we no longer know why in 1927 he began to work intensively in this area. It was probably to do with his bronze lacquer cigarette tips: he used lacquer to set pulverized hardened steel on a paper strip, thus obtaining a magnetizable information carrier. Unlike the steel material used until then, the magnetic tape could be cut and glued, was lighter than steel and in his opinion could be produced much more cheaply than information carriers made simply of steel.

In order to sell his inventions, in the Spring of 1928 he built a magnetic tape apparatus for demonstration purposes, produced tapes, recorded onto them and demonstrated the apparatus to the technical editors of various leading Berlin daily newspapers: first of all to Dr. Neuberger of the "Morgenpost" published by Ullstein, then to Herr Kluth of the "Berliner Lokal-Anzeiger" and other experts. There was general amazement at the long playing time and the sound quality of which the tape

was capable. The possibility of using scissors and adhesive to edit the tape to requirements was found particularly impressive. To do this with information carriers of hardened steel would have required complicated cutting tools and soldering irons. In fact, these newspapers then also carried reports on the new sound recording technique - without the success Pfleumer had hoped for. (11) No company came forward to take up his idea.

Pfleumer did not give up, on the contrary. He continued to work on improving the magnetic tape, the magnetic sound recording technique and the components required. Up to 1931, which marked something of an end to his developments, this resulted in various applications and three further German patents (12) (13) (14).

In 1931, reports attesting to the current state of Pfleumer's work again appeared in newspapers and journals. (10) (15). Werner R. Kuhn, a reporter for the Dresden Neue Presse, visited Pfleumer at his Dresden home and reported on the demonstration of the magnetic tape device and his conversation with the inventor.

An excerpt from this reads as follows: " ... Here stood the test apparatus. Imagine if you will a gramophone. First of all the "box". Narrower than usual, but somewhat longer, and on average of the same height. If you then open up the lid, you find not one but two rotating reels. Each of about half the diameter of the turntable of a gramophone. And, like the ink ribbon on a typewriter, a paper strip is wound up on the left. It glides - again in the manner of an ink ribbon - past a magnet and is wound up again on the right by a reel driven by an electric motor. Apart from a lot of wires, accumulators, an amplifier, loudspeaker and the power connection, there is not much more on the table".

Pfleumer played Kuhn instrumental music, singing and an organ recital, during which "sometimes the sounds (were reproduced) extremely clearly, sometimes extraneous noises could be loudly heard".

As the report reveals, the tape was 16 mm wide and even then two tracks were used. To run for 20 minutes, 300 m of tape was required, that is to say the tape speed was on average 25 cm/s (about 10 inches/s). Pfleumer said that 300 m of tape could be produced for 1.50 Reichsmarks and that he was also thinking of the playing back of prerecorded tapes. He claimed that, even after running through 500 times, no wear occurred. He also went on to say, as the reporter remarked, "in his

characteristic slight Salzburg accent" that "apparatus-producing companies were showing a strong interest".

A further brief description of his apparatus at that time appeared in issue 37/1931 of the journal "Umschau" on page 941, along with a photo of the inventor. (Fig. 1)

At that time, Pfleumer had established contacts with various companies, among them AEG and Siemens, with a view to production of equipment and magnetic tapes, as well as with the chemical company von Heyden of Radebeul near Dresden with a view to tapes. (16) (17) (18)

COOPERATION WITH AEG

To enable us to appreciate Pfleumer's significance in the early days of the development of magnetic tape technology, we have to look briefly at the consequences resulting from his persistence.

On June 8, 1932, an option agreement was reached between him and AEG for the period up until December 1, 1932 and on November 28, 1932 a contract to extend until December 31, 1950 was signed. This gave AEG the rights already granted and resulting from his future work in the field of magnetic sound recording, in return for payment of licenses with respect to both the sales of sound recording carriers and drives of magnetic systems, as the wording of the contract put it. Even the associated amplifiers, tubes excepted, were under license. In addition, this contract committed him in 6 to advise AEG as a member of their staff in all matters relating to the subject-matter of the contract. (19) (20)

The head of AEG, Privy Councillor Bücher, backed the magnetic sound recording idea from the start and arranged for the appropriate organizational setup at his company. In those days, AEG was concerned not only with the development and production of radio sets, but also with other products utilizing audio frequency technology. These included sound film recording equipment using a Kerr cell as light modulating component (21), as well as gramophone players, comprising electrical pick-ups, amplifiers and loudspeakers. (22) In this respect, magnetic sound recording fitted into their range.

Immediately the contract had been concluded, work began on the development of both equipment and magnetic tapes at the telecommunications laboratory of AEG's cable works on the Upper Spree, initially under the direction of Dr. Theo Volk. The first working prototype was demonstrated at an internal presentation on the occasion of company celebrations in the Fall of 1933. (Fig. 2) In the photo you can see, third from the left, Dr. Volk and, third from the right, Eduard Schüller, who took over in charge of the development of magnetic tape equipment when Dr. Volk stepped down in 1935. The tapes were produced to Pfleumer's specifications in the AEG laboratory itself. The magnetizable material was supplied by the Berlin company Hameta.

A copy has been preserved of the sound recording produced on a laboratory apparatus (Fig. 3) at the stage of development reached in 1934.

It soon became apparent that the development of the magnetic tape was beyond a large electrical engineering concern such as AEG. It is presumed that two factors played a part in bringing about cooperation between AEG and IG Farben, Ludwigshafen works, today's BASF, to develop the tapes.

For years, AEG had obtained carbonyl iron from Ludwigshafen for the manufacture of Pupin coils, which were used in the production of telephone lines. Carbonyl iron was better suited than pulverized steel for the coating of the tapes. (23) (24)

Furthermore, there was a close personal friendship between the heads of the companies AEG and IG Farben, Privy Councillor Bosch and Privy Councillor Bücher. (9) Cooperation involving high risks and costs, based only on agreements between these gentlemen, began in the year 1932. It was not until Magnetophon GmbH was founded in 1942, each of the two companies taking a 50% interest, that this joint venture was contractually formalized. The contract provided that IG Ludwigshafen would continue with the development and production of the magnetic tapes, whilst AEG would continue with the development and production of the equipment as well as with supplying customers with equipment and tapes. (25)

Here are some excerpts from the correspondence at that time between AEG and the IG Ludwigshafen works:

(Letter from Dr. Simon, AEG senior works management to Dr. Ambros, Ludwigshafen, dated November 24, 1932) "... Today I would like to take the opportunity to announce to you the arrival of our Herr Pagel .. . I would be extremely pleased if you would give Herr Pagel the opportunity to discuss with Herr Dr. Matthias and Herr Friedmann details of further iron tape tests. .." (26)

(Letter from Dr. Gaus, head of IG Ludwigshafen to Privy Councillor Bücher, dated January 12, 1933) " .. I found your work on magnetic audio tapes of particular interest, since I am convinced that I.G. can, with carbonyl iron and its experience in the field of plastics, assist your work decisively. .." (27)

The commitment with which AEG, for example, went about realizing Pfleumer's ideas is shown by how much they invested in their development. Here is one figure: up until 1938, 310,000 Reichsmarks were invested. (28)

The developments and preparations for production which went on at IG had the result that, even as early as 1934, the company turned out 50 km of magnetic tape, 6.5 mm wide on an acetyl cellulose base with a carbonyl iron coating. (29) At the Berlin Radio Exhibition in August 1935, AEG presented the portable Magnetophon K1 and the cabinet set T1 together with the IG Farben magnetic tape Type C. The result: a sensational success. (6) (Fig. 4)

Up until the end of the war, the further development of equipment at AEG as well as at the Reichsrundfunk Gesellschaft (German Imperial Broadcasting Company) and of tapes in Ludwigshafen brought about the following improvements, among others: extending of the frequency band to 10,000 Hz; dynamic range 60 dB; two-channel stereophonics; reduction in tape speed from 1 m/s to 76 cm/s and then to 18 cm/s for reporting purposes; (6) storage medium Fe_3O_4, discovered by Pfleumer back in 1933 and patented for him in DRP 649 408 "Magnetogrammträger" (Magnetogram carrier), and subsequently gamma Fe_2O_3, which is still used today.

Of Pfleumer's numerous patents and patent applications, mention will be made here, as examples of his creativity in the field of equipment technology too, of his DRP 612 489 "Verfahren und Vorrichtung zum Vormagnetisieren bandförmiger Magnetogrammträger" (Process and apparatus for premagnetizing magnetogram carriers in tape form) of November 22, 1931 and DRP 617 796 "Sprechkopf zur Wiedergabe von in Längsmagnetisierung aufgezeichneter Lautschrift" (Recording

head for reproducing sound recorded by longitudinal magnetization) of November 26, 1932. Both concern for the first time a head with a virtually closed magnetic circuit, interrupted only by the gap forming the two poles, similar to a head having different design features which was also patented by Schüller at the end of 1933. The first-mentioned invention relates to a recording head, the second to a reproducing head. (30) (31) (Figs. 5 and 6)

Another of Pfleumer's inventions, dating back to about 1934, has nothing at all to do with magnetic sound recording, but much to do with the application of magnetism. To solve a problem in the field of cigarette packaging, he invented a special magnetic sensor. Before the war, cigarettes were often sold in boxes with a hinged lid, the company imprint on one side of the cigarette having to face upward. A process patented by the Siemens company determined the position of the cigarette electro-optically and, before the placing of the cigarette into the pack, activated a turning device if it was the wrong way round. Pfleumer got around this principle by mixing magnetizable particles in the printing ink and using a magnetic sensor to detect the position of the cigarette. At AEG's Magnetophon laboratory, special magnetic heads were built for appropriate tests, with which Pfleumer then experimented. (32)

At the request of the company Siemens & Halske, on November 1, 1934 the Pfleumer "Lautschriftenträger" patent was declared null. This nullity was confirmed in appeal proceedings before the Imperial Court on April 20, 1936. The reason: the US patent of the American O'Neill, "RECORD FOR REPRODUCING SOUND TONES AND ACTION", filed on March 22, 1926, as well as a prior publication of the Russian, resident in Berlin, Nazarishvili. (33) (34) In contrast to the successful applications resulting from Pfleumer's inventions, the prior inventions mentioned were not taken up and did not provide any technical or commercial initiatives.

Pfleumer's activities also paid off for him. He, and later his widow, received license fees from AEG up until 1950, the end of the contract.

On August 29, 1945, Pfleumer was fatally injured when knocked down by a truck in the Dresden suburb of Radebeul.

In retrospect it is clear that his activities marked the dawning of the magnetic tape age.

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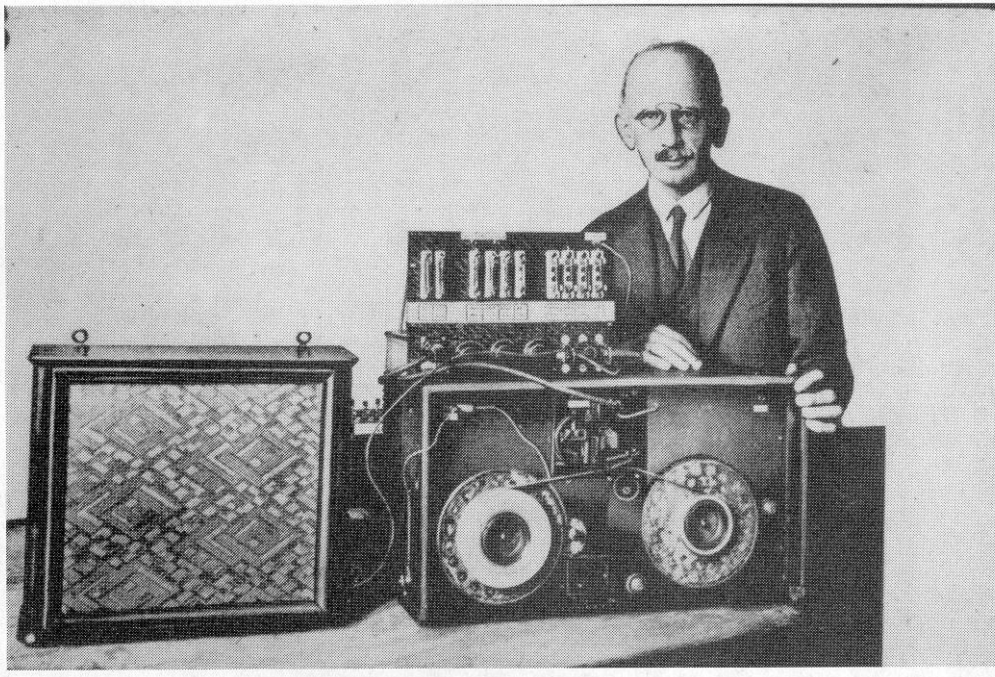


Fig. 1 Pfleumer and his demonstration recorder, 1931

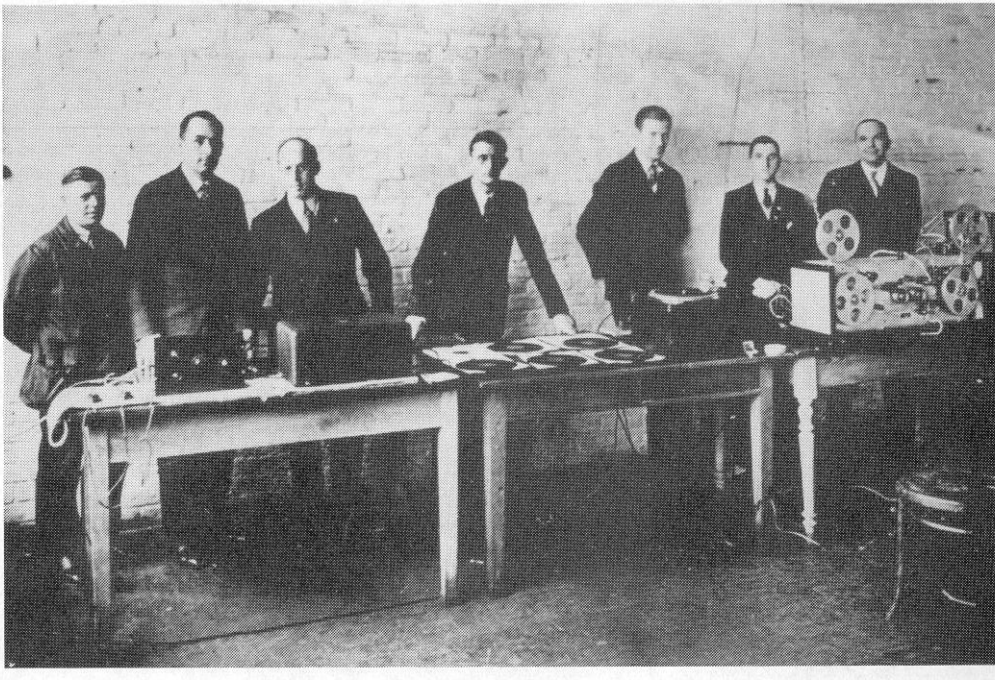


Fig. 2 AEG recorder, lab model # 1, 1933

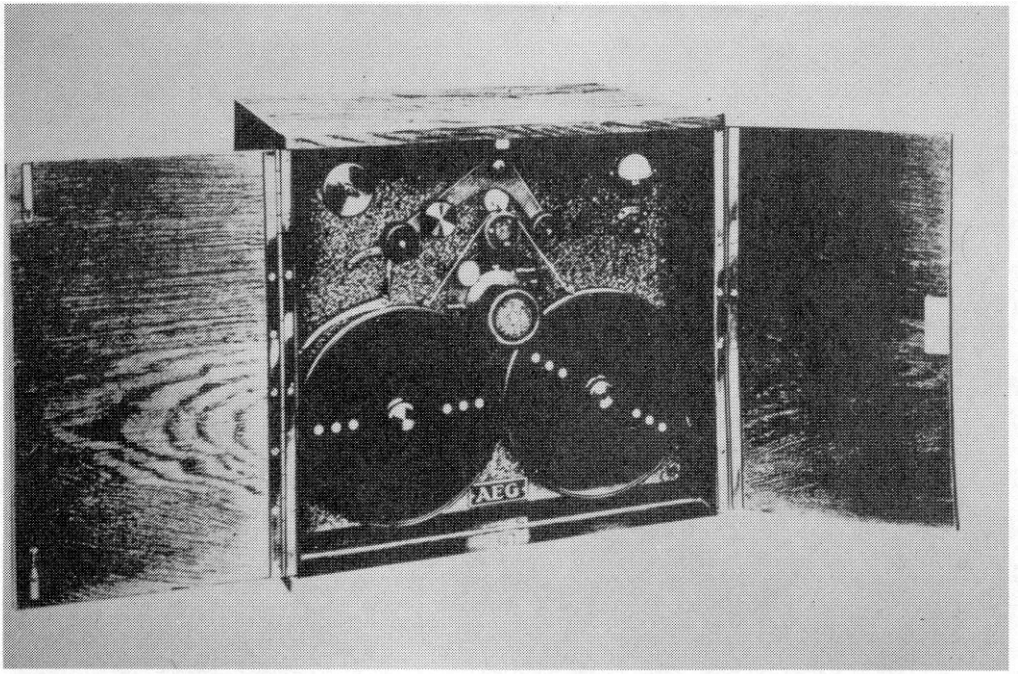


Fig. 3 AEG recorder, lab model # 2, 1934

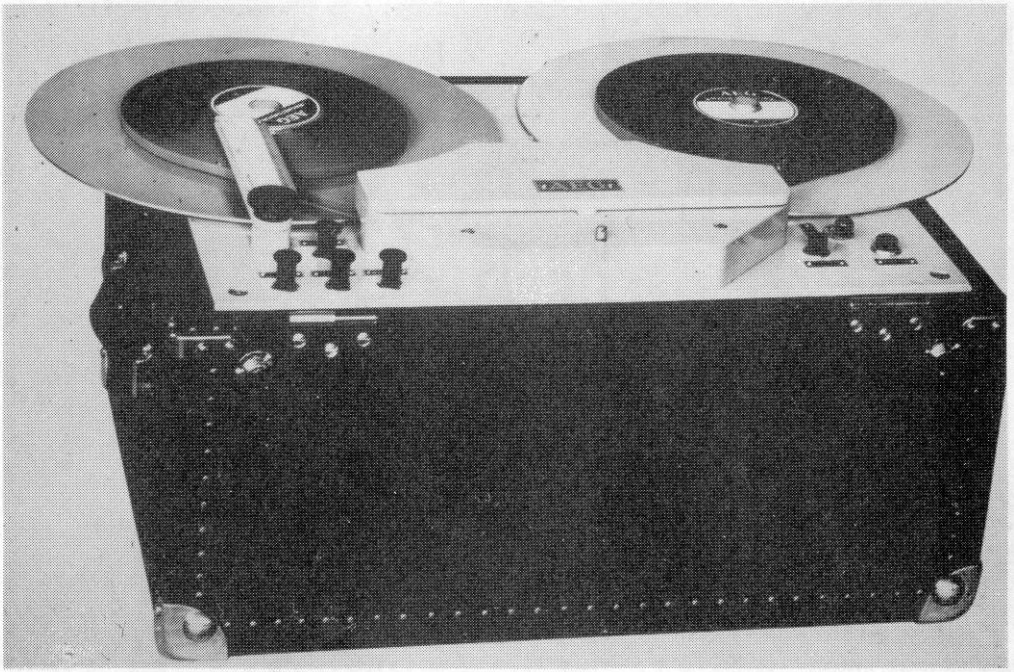


Fig. 4 AEG recorder, Magnetophon K1, 1935

Fig. 5 Pfleumer invention: recording head, 193I

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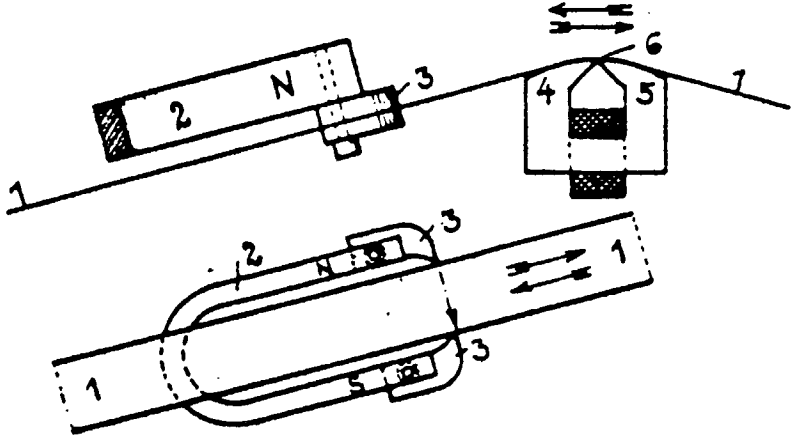


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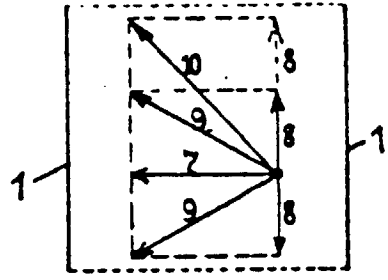


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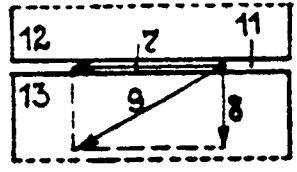


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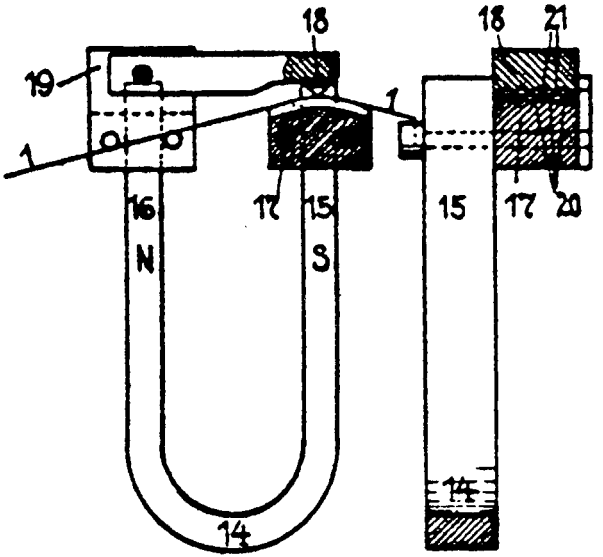


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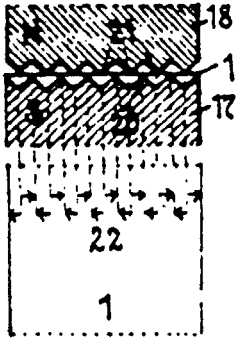


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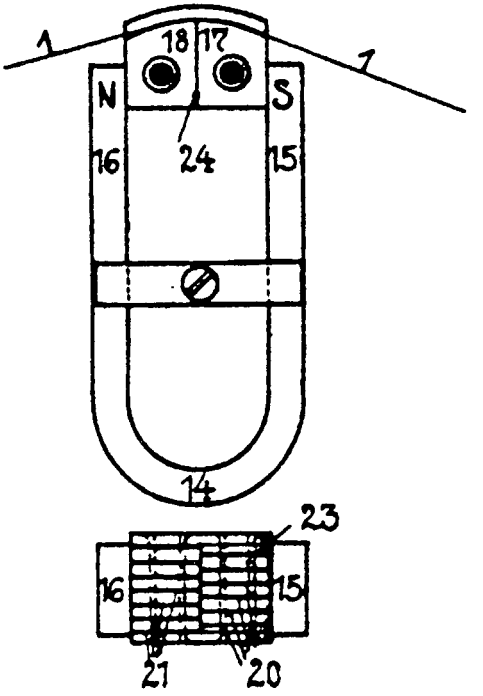
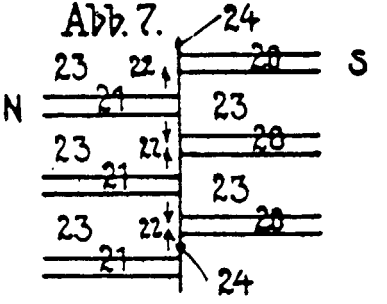


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Fig. 6 Pfleumer invention: reproduce head, 1932

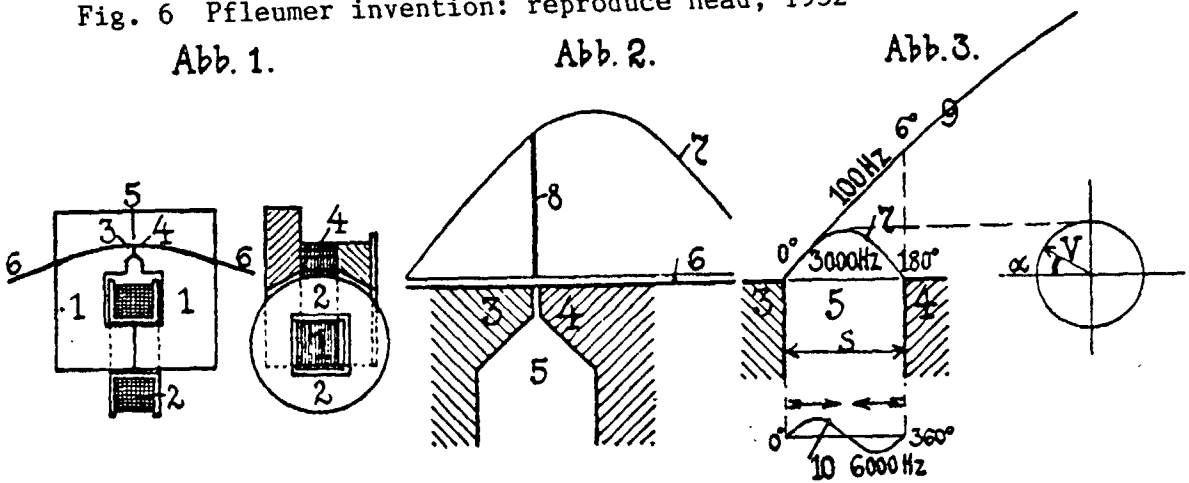


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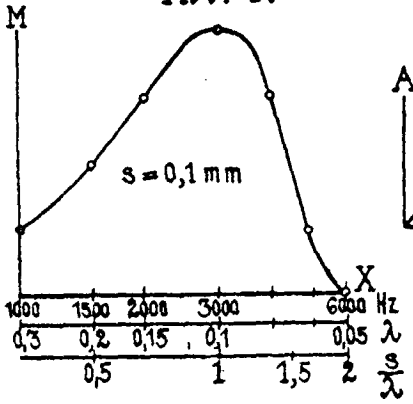


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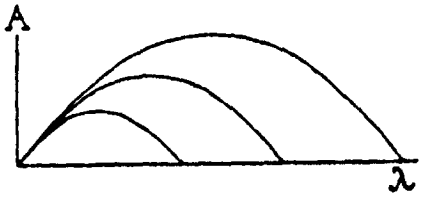


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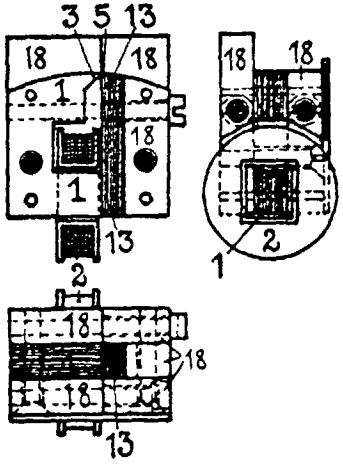


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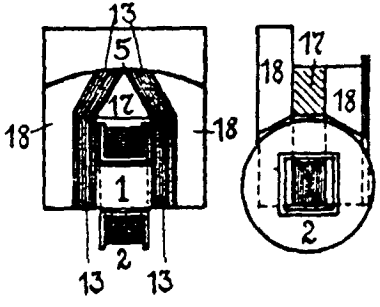


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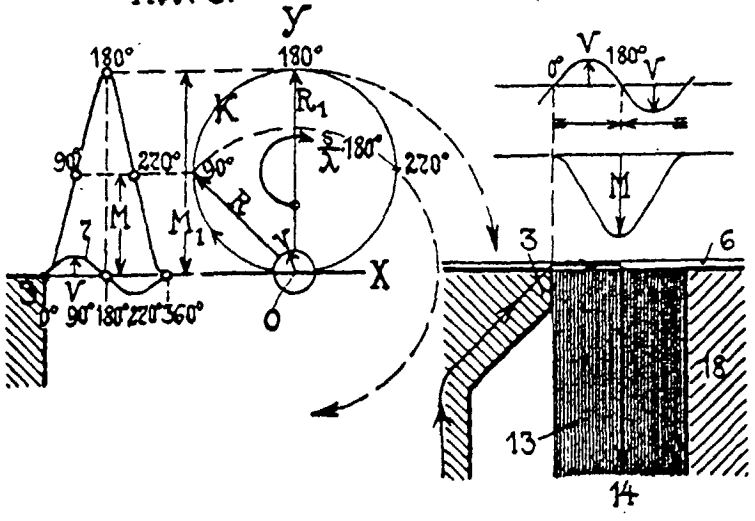


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