THE DEVELOPMENT OF MACHINELESS PERMANENT WAVING*

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In the evolution of the permanent waving of hair on the human head, there have existed two distinct periods—one given to the development of the mechanical phase, the other to the chemical phase.

The mechanical phase started, as has been many times repeated, with the invention of Charles Nessler about 1905, who was the first to permanently wave hair successfully on the human head. While chemicals were involved in this process, the primary problem here was the safe production of satisfactory heat close to the human scalp.

Developments from this initial start were directed toward mechanical and electrical contrivances for safe and satisfactory waving of hair. Thermostatic controls, split heaters, different types of mandrels, etc., were the object of innumerable patents during the period up to and through the twenties. The revolutionary mandrel and winding process of Robert Bishinger (Patent No. 1,710,929) which led to the now almost universally used croquignole method climaxed these mechanical-electrical advances in the art of permanent waving.

During this time practically no advance had occurred in the chemical phase of the permanent waving of hair. Borax, originally used by Nessler, had given way largely to ammonia or ammonia and borax or other alkaline salts such as carbonates and phosphates, but ammonia in combination with heat had been used in the wig-producing days.

Thus the commercial competition in the field during the twenties was the competition of mechanical and electrical ingenuity, and all of the great American permanent waving organizations of that time, including Frederick, Eugene, and Nestlé, employed mechanical and electrical engineers to improve their products.

So far had the art progressed in the use of electrical heat, that the introduction of a new system imported from England produced not any more than a faint ripple of acceptance.

This system or process was the

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basic invention of an Englishman, Peter Sartory (U. S. Patent No. 1,565,509). The process involved the first use of an exothermic chemical reaction for the generation of the heat sufficient to permanent wave hair.

However, as with many original ideas, Sartory was influenced by the predominant factor in the art, which was the electrical machine, and Sartory's utilization of his idea of using chemical heat instead of electrical heat resulted in a mechanical set-up which in appearance as well as in operation was very much like the electrical machine.

Actually the chandelier contraption was a necessity in the Sartory concept, because by selecting the hydration of lime as his exothermic chemical reaction, and in applying his concept of how it should be used, that is, as a functional duplicate of the electrical machines, Sartory generated temperatures similar in range and duration to those of the electrical heaters, and this required a very large amount of lime to wave each strand of hair.

These lime heaters also required some means of support, and in order to have a steam-retaining unit, a rigid casing was used around the porous lime container. In order to introduce the water, a bulb-syringe was inserted into an inlet on this external casing.

The water, starting at the outer side of the layer of lime, generated heat according to the reaction

$$CaO + H_2O \longrightarrow Ca(OH)_2 + \Delta$$

This raised the excess water to steam which reacted with the next layer of CaO to generate further heat and thus steam at a higher temperature until the steam coming from the internal (next to the hair) section of the calcium oxide was in many instances around 500°F. and sufficient to char paper—typical of the electrical units.

It is little wonder that this crude invention did not receive a ready acceptance in competition with the highly developed electrical units and that the organization offering it in America soon went into bankruptcy.

However, this unit may be looked upon as the forerunner of the active chemical phase in the American permanent wave art.

Dr. R. L. Evans (who purchased the bankrupt organization) and coworkers investigated this process thoroughly but soon came to the conclusion that it could not compete with the highly developed electrical heating systems.

But as so often happens, where logic and science acknowledge a blind alley, a less scientific and more ingenious mind will find a way out.

This was the case here. Not a chemist or an electrical engineer, but a very ingenious hairdresser named Fred Winkel from the Pennsylvania mountains, without knowledge of chemistry and without knowledge that commercially exothermic chemical heat had bowed to electrical heat, was able to reawaken the interest in exothermic chemical heat and actually produce and successfully operate the first

means and method which today are known as "machineless" pads used and the "machineless method" of permanent waving of hair.

The term "machineless" aptly describes the system because for the first time women were emancipated from wires and overhanging supports.

As with many basic inventions, in retrospection and upon casual examination it appears to be simple and obvious.

Primarily Winkel's invention (U. S. Patent No. 2,051,063) involved the use of a single moisture-absorbent element to accomplish the following functions: (1) to supply the water to initiate and continue the exothermic chemical reaction; (2) to serve as a wet shield to prevent the hair from being damaged by being heated to a high dry heat; (3) to serve as a fast heat conductant to the wound hair strand since the element lay between the hair and the envelope containing the exothermic heat.

The second element of Winkel's invention involved the use of a flexible impervious envelope, one face of which was perforated. Thus the water was pressed through the perforation to the chemical. The heat generated was quickly transferred by the wet element to the hair, thus raising its temperature almost as fast as the temperature within the pad. The impervious envelope by permitting the steam to issue in only one direction allowed for only little heat to escape by radiation except in the direction of the hair. What heat was not used, as with a small swatch of hair, escaped as steam, but the wet absorbent, serving as the water giving means and the system depending upon water for exothermic reaction, became an automatic control to assure that no overheating to a dry state occurred.

The very high efficiency of this unit allowed for a marked decrease in the amount of heat required—the Winkel pad requiring only 12 gm. of lime, while the Sartory system required about three times this amount (actually 35 gm.).

The Winkel pad was not a perfect pad even though it was used commercially, but Evans and his coworkers immediately saw with their background of experience with the Sartory set-up that here was the opening to the blind alley. Sales Affiliates, Evans' company, bought the Winkel invention, and Evans started an intensive research program to improve the product.

The first of the improvements was the overcoming of one of the major limitations of the Winkel pad. This was the lack of an assured and standard control over the generation of the heat by the exothermic chemical reaction. Evans was the first to recognize that this could be done chemically and Patents 1,892,426, 1,894,032, and 1,919,690 were issued to him.

In the very first stages of work on the Winkel machineless pad, it was recognized by Evans and McDonough that other exothermic chemical reactions would better serve to generate the heat than the hydra-

tion of lime, which Winkel's patent mentions as a suitable example of exothermic reaction.

Among the many reactions studied, the oxidation-reduction type of reaction involving the oxidation of a metal like aluminum with an oxidizer like a chlorate offered the most possibilities. The explosive violence with which aluminum combined with an oxidizer to generate a very intense heat and high temperature had been put to use in the metal thermit welding units of Goldschmidt.

$$Al + Fe_2O_3 \longrightarrow Al_2O_3 + Fe + \Delta$$

How to control this type of reaction became the subject of a research program, giving rise to the invention specified in the Evans and McDonough patent U. S. No. Re 22,660.

In this research program it was found that the reaction must involve an electron transfer through a solution means rather than a direct combination of materials. Even with this type of reaction the reaction can either be so slow as to generate no perceptible heat or so violent that the steam development will drive out all the water and will generate temperatures giving rise to direct combination which, of course, results in heat of the intensity of bombs.

Means for smoothing out the electron transfers therefore became a problem which was solved through (1) the use of materials to control the hydrogen ion, particularly at the start of the reaction, and (2) the inclusion of materials which would give rise in the reaction mixture to catalysts; for example, a nascent metallic element like copper, which would assist the aluminum metal in the loss of electron and a metallic ion like the cupric ion which would assist the chlorate ion in the acceptance of the electron.

The inclusion of an absorbent material within the mixture is a necessity not only to give body to the water solution but also to prevent spontaneous combustion which might result from direct combination of the reducing agent and oxidizing agent if only they were mixed together and subjected to high storage temperatures on mechanical attrition.

Compositions utilizing the oxidation of a metal like aluminum to generate heat for the permanent waving of hair have been disclosed in the Racen U. S. Patent 2,183,587 and Reed's U. S. Patent 2,208,815.

The impervious perforable envelope of Winkel was made of aluminum foil, and so far no better substitute material has been found, even though during the war numerous substitutes had to be resorted to.

The element carrying the water in Winkel's original pad was flannel, and while he specified that it must be adapted to be wet with a liquid and that it must give up through the perforation a part of the liquid to the exothermic mixture, nevertheless, the flannels were a source of trouble. This was due to the fact that it was hard to get flannel having the standard properties for speedy

wetting, a capacity for absorbing a uniform weight of water per area and giving up a uniform amount to the exothermic chemical.

Investigation of this problem resulted in the study of many materials, none of which solved the problem. In the study of papers as an absorbent, Evans and McDonough finally developed a special element primarily composed of multiple layers of crepe paper. This absorbent had the water absorptive, wet strength, and water-releasing characteristics desired. This invention was the subject of U. S. Patent No. 2,151,692.

While the reaction within a machineless pad proceeds automatically, nevertheless, we felt that if the operator had visual evidence that the pad was functioning properly, it would not only be an assurance and an aid to the operator in checking that she has performed her task properly, but it would also serve to show when the wave was finished.

To accomplish this it became necessary to create a pad which contained this signaling unit. By using a combination of mercuric iodide and cuprous iodide, we were able to arrive at a pigment which exactly changed colors at hair waving temperatures and reverted to its original color to show as it cooled down that the pad could be removed without affecting the curl. This invention is described in Evans and McDonough U. S. Patent No. 2,196,201.

Other improvement modifications of the original Winkel patent which deserve mentioning here are the following inventions. As a means of briefly indicating the scope of the invention one or more claims will be given. The patents are divided into related types of improvements.

The first of the following group are directed toward a pad construction which has become increasingly popular since the war, the pad construction being adopted by the so-called "oil-fired" machineless waving discussed in the second group of patents below and also by the built-in absorbent of the unitary pad—so-called "water-dipped" pads.

U. S. Patent No. 2,051,667 to Y. Worth is the most basic of this group of pads as can be seen from the following two claims: Cl. 1—a hair waving pad comprising an outer layer of non-absorbent material and an inner layer of absorbent material containing an exothermic material; Cl. 13—a hair waving pad including a flexible pervious envelope and a backing of flexible material.

U. S. Patent No. 2,349,285 to F. Korf and W. Zentler is next most basic as can be seen from Cl. 28: A hair waving pad comprising a layer of impervious non-soluble material, a layer of porous, absorbent material, chemical means disposed between said porous and non-porous materials, and means for holding said layers together and confining the chemical means therebetween, thus forming a unitary pad which requires only the application of a liquid to be ready for use.

U. S. Patent No. 2,110,667 to F. Racen is a specific type of con-

struction embodying the basic principles of Worth and Korf-Zentler as can be seen from Cl. 1: As a complete unit of manufacture and application, a container, and exothermic substance therein, at least a portion of said container in contact with said substance being of imperforate material which readily transmits a liquid therethrough and another portion of said container in contact with said substance being of material which is highly resistant to the passage of moisture therethrough.

The second group of improvements are directed at pad construction to effect certain types of chemical reactions.

Most basic of this group is the U. S. Patent No. 2,431,220 to Evans and McDonough. The broad concept of this patent is shown by the fact that before issuing it became involved in no less than seven interferences and although filed it has just issued.

That this pad covers the "oil-fired" pad idea as well as the oxidation of sheet metal is shown by the following claim. Claim 5 states: A heating pad for the permanent waving of hair having ingredients, certain of which are unmixed but which when in sufficiently intimate contact with each other react to generate heat, certain of said ingredients when treated with a solvent passing into sufficiently intimate contact with the remainder of said ingredients to generate heat.

U. S. Patent No. 2,239,410 to Bonat covered one specific composition of the so-called oil-fired pad. All the claims are directed toward a composition containing glycerine, whose oily feel in the absorbent gave rise to the term "oil" pads.

Similarly U. S. Patent 2,350,926 to Reed covers, as is shown in the following claim, the use of hexahydric alcohols such as sorbitol, mannitol, and dulcitol. A typical claim, 3, reads: A chemical composition capable of generating heat upon the addition of water thereto, said composition including a hexahydric alcohol and an oxidizing agent comprising a permanganate which is sufficiently soluble in water to effect the heat-generating reaction upon addition of water to the composition.

Various patents (2,132,681 to Davis, 2,133,115 to Reynolds, 2,144,811 to Reynolds, 2,153,671 to Markel and Reynolds, 2,153,676 to Reynolds, 2,153,677 to Reynolds, Reissue 21,276 to original 2,153,678 to Reynolds) have been issued on the use of oxidizing of a sheet or sheets of aluminum foil. As stated above, the more important of these were losers in interferences with the Evans and McDonough U. S. Patent No. 2,431,220.

A third group of patents directed toward the machineless permanent waving art relates to improvements in the clip used to hold the pad in place when the croquignole type of winding was used.

It was quite obvious that a paper type clip could be used to hold the Winkel pad about the croquignole wound hair, but Evans and Winkel (U. S. Patent No. 1,925,527) de-

veloped the first adoption of the conventional Bishinger croquignole clip to a self-pad holding clip. Evans U. S. Patent No. 1,927,544 was an even greater improvement which was followed by Koehler's U. S. 2,261,163.

All of the above are merely the high spots in the development of the machineless art, but hand in hand with this development went the commercial acceptance of machineless permanent waving. Before January, 1932, may be considered the zero figure commercially for machineless waving although a few pads were sold. From this zero start and battling the already firmly and highly developed electrical waving, the machineless pads had reached at the start of the war an estimated sale of four to five hundred million pads per year and represented about 50 to 60 per cent of the total waves given in the permanent waving industry.

Even today as the intensity of scientific investigation leads away from thermochemistry to advanced organic chemistry, machineless waving is still holding its total gross volume of pads sold annually, here and abroad.