This invention relates to the treatment of hair as in the
permanent waving thereof.

An object of this invention is to provide an improved
process for waving the hair and chemicals for use in waving
the hair.

A further object of this invention is to provide a hair
waving method and chemicals for use in hair waving
which produce curls which retain a tight uniform helical
shape on drying and which maintains its improved shape
after repeated washings or other treatments which nor-
mally weaken curl structure.

In the waving of hair, it is common practice to soften
or treat the hair with a reducing solution such as a solu-
tion of thioglycolic acid and ammonium hydroxide in
water which produces changes in the hair by reducing keratin
and which softens the hair to permit shaping of the
hair on a mandrel such as a curling rod or the like.

An oxidizing agent is applied to the treated hair to neutral-
ize that portion of the reducing agent which remains on
the hair and to oxidize the reduced keratin to restore the
strength thereof, but the strength is only partially rest-
ored upon treatment with the oxidizing agent. Accord-
ing to our improved method, we add a water-soluble,
non-toxic salt of a polyvalent metal such as magnesium
sulfate, sodium sulfate, calcium acetate, calcium chlor-
ide, or the like to an aqueous solution of oxidizing agent.

Alternatively, we employ an aqueous solution of an oxidizing
salt of a polyvalent metal such as magnesium bromate,
calcium bromate, aluminum bromate or the corresponding
iodates or mixtures thereof in neutralizing and treating
reduced keratin of the hair. The hair fibres of waves
neutralized with our improved compositions have a sub-
stantially greater tensile strength than hair fibres neutral-
ized with conventional oxidizing solutions, and the waves
are longer lasting and have a lesser tendency for fibres to
separate from one another.

Oxidizing agents with which our salts can be used in-
clude water-soluble ammonium, alkali and alkaline earth
bromates, iodates, and periodates, hydrogen peroxide,
and urea peroxide and the like.

Mixtures of the oxidizing agent and polyvalent salt can be
made to form a mixture which can be dissolved in
water, and in such a mixture, the oxidizing agent and poly-
valent salt can be mixed in approximately the ratio de-
sired in the neutralizing solution. An example of such a
mixture contains 100 parts of sodium bromate and 280
parts of MgSO₄·7H₂O, all parts being by weight. In
the neutralizer solution, it is preferred to have substan-
tially as great a concentration of polyvalent salt as can be main-
tained in solution conveniently in order to obtain the
maximum effect from the polyvalent salt, but lesser con-
centrations can be used if desired.

The following examples are given to illustrate the in-
vention in greater detail, but it is to be understood that the
examples are given primarily by way of example, rather
than by way of limitation, except as set forth in the
claims. In the following examples and in the remainder
hereof, all parts or percentages are given by weight.

Example I

A tress of hair including approximately 12 fibres of
human hair was wrapped around a quarter-inch mandrel in
helical fashion for three complete revolutions and held
in place thereon. The tress was immersed in a reductant
solution containing 7.0% thioglycolic acid and sufficient
ammonia to provide an excess and gave a pH of 9.4. The
tress was immersed in the reductant for approximately 7
minutes and was then rinsed thoroughly in tepid water.
The tress was then immersed in a neutralizer solution
which contained 100 parts of sodium bromate, 280 parts
of MgSO₄·7H₂O, 3 parts of sodium laurel ether sulfate
with sufficient sulfuric acid to bring the composi-
tion to a pH of 6.0 and sufficient water to make 1,000
parts of neutralizer solution. The tress was immersed in
the neutralizer for 7 minutes. The tress was then rinsed
in tepid water and removed from the mandrel. On dry-
ing in air, the tress retained its uniform helical shape
with very little change in diameter and the individual fibres
showed no tendency to lose their helical shape or separate
from one another. On immersion in water, the tress ex-
hibited practically no motion at all, neither expanding into
a large helix nor contracting into a tight knotted configura-
tion.

Example II

A tress of hair including approximately 12 fibres of
human hair was wrapped around a quarter-inch mandrel in
helical fashion, for three complete revolutions and held
in place thereon. The tress was immersed in a reductant
solution containing 7.0% thioglycolic acid and sufficient
ammonia to provide an excess and give a pH of 9.4. The
tress was immersed in the reductant for approximately
7 minutes and was then rinsed thoroughly in tepid water.
The tress was then immersed in a neutralizer solution
which contained 100 parts of sodium bromate, 180 parts
of Ca(C₂H₅O₃)₂·2H₂O, 3 parts of sodium laurel ether
sulfate, sufficient sulfuric acid to bring the composition to
a pH of 6.0 and sufficient water to make 1,000 parts of
neutralizer. The tress was immersed in the neutralizer
for 7 minutes. The tress was then rinsed in tepid water
and removed from the mandrel. On drying in air, the
tress retained its uniform helical shape with very little
change in diameter and the individual fibres showed no
tendency to lose their helical shape or separate from one
another.

Example III

A tress of hair including approximately 12 fibres of hu-
man hair was wrapped around a quarter-inch mandrel in
helical fashion, for three complete revolutions and held
in place thereon. The tress was immersed in a reductant
solution containing 7.0% thioglycolic acid and sufficient
ammonia to provide an excess and give a pH of 9.4. The
tress was immersed in the reductant for approximately
7 minutes and was then rinsed thoroughly in tepid water.
The tress was then immersed in a neutralizer solution. In the preparation of the neutralizer, 100 parts of sodium bromate, 15 parts of boric acid and 3 parts of sodium alkyl phenoxynethyl sulfate were dissolved in 882 parts of water to form a first solution. 38 parts of $\text{Al}_3(\text{SO}_4)_2\cdot 18\text{H}_2\text{O}$

were dissolved in 62 parts of the first solution, and the resultant neutralizer solution was used at once. The tress was immersed in the neutralizer solution for 7 minutes. The tress was then rinsed in tepid water and removed from the mandrel. On drying in air, the tress retained its uniform helical shape with very little change in diameter and the individual fibres showed no tendency to lose their helical shape or separate from one another.

**Example IV**

A tress of hair including approximately 12 fibres of human hair was wrapped around a quarter-inch mandrel in helical fashion, for three complete revolutions and held in place thereon. The tress was immersed in a reductant solution containing 7.0% thioglycolic acid and sufficient ammonia to provide an excess and give a pH of 9.4. The tress was immersed in the reductant for approximately 7 minutes and was then rinsed thoroughly in tepid water. The tress was then immersed in a neutralizer solution which contained 20 parts of sodium periodate, 200 parts of $\text{MgSO}_4\cdot 7\text{H}_2\text{O}$ and sufficient water to make 1,000 parts of neutralizer. The tress was immersed in the neutralizer for 7 minutes. The tress was then rinsed in tepid water and removed from the mandrel. On drying in air, the tress retained its uniform helical shape with very little change in diameter and the individual fibres showed no tendency to lose their helical shape or separate from one another.

**Example V**

A tress of hair including approximately 12 fibres of human hair was wrapped around a quarter-inch mandrel in helical fashion, for three complete revolutions and held in place thereon. The tress was immersed in a reductant solution containing 7.0% thioglycolic acid and sufficient ammonia to provide an excess and give a pH of 9.4. The tress was immersed in the reductant for approximately 7 minutes and was then rinsed thoroughly in tepid water. The tress was then immersed in a neutralizer solution which contained 20 parts of sodium periodate, 300 parts of $\text{MgSO}_4\cdot 7\text{H}_2\text{O}$ and sufficient water to make 1,000 parts of neutralizer. The tress was immersed in the neutralizer for 7 minutes. The tress was then rinsed in tepid water and removed from the mandrel. On drying in air, the tress retained its uniform helical shape with very little change in diameter and the individual fibres showed no tendency to lose their helical shape or separate from one another.

**Example VI**

A tress of hair including approximately 12 fibres of human hair was wrapped around a quarter-inch mandrel in helical fashion, for three complete revolutions and held in place thereon. The tress was immersed in a reductant solution containing 7.0% thioglycolic acid and sufficient ammonia to provide an excess and give a pH of 9.4. The tress was immersed in the reductant for approximately 7 minutes and was then rinsed thoroughly in tepid water. The tress was then immersed in a neutralizer solution which contained 250 parts of commercial 6% hydrogen peroxide solution in water, 200 parts of $\text{Ca(C}_2\text{H}_2\text{O}_2)_2\cdot \text{H}_2\text{O}$

and sufficient water to make 1,000 parts of neutralizer. The tress was immersed in the neutralizer for 7 minutes. The tress was then rinsed in tepid water and removed from the mandrel. On drying in air, the tress retained its uniform helical shape with very little change in diameter and the individual fibres showed no tendency to lose their helical shape or separate from one another.

The neutralizing composition and method of treating hair are subject to variation within the spirit and scope of the appended claims.

Having described our invention, what we claim as new and desire to protect by Letters Patent is:

1. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent for reduced keratin, the improvement which comprises including in the solution of oxidizing agent at least 18 percent by weight of a water soluble non-toxic salt of a polyvalent metal selected from the group consisting of magnesium, aluminum, and calcium.

2. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent for reduced keratin, the improvement which comprises including in the solution of oxidizing agent at least 20 percent by weight of magnesium sulfate.

3. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent for reduced keratin, the improvement which comprises including in the solution of oxidizing agent at least 20 percent by weight of aluminum sulfate.

4. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent for reduced keratin, the improvement which comprises including in the solution of oxidizing agent approximately 18 to 20 percent by weight of calcium acetate.

5. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent for reduced keratin, the improvement which comprises including in the solution of oxidizing agent at least 18 percent by weight of a water-soluble non-toxic salt of a polyvalent metal selected from the group consisting of magnesium, calcium and aluminum.

6. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent selected from the group consisting of soluble ammonium, alkali, and alkaline earth iodates, periodates, and bromates, hydrogen peroxide and urea peroxide, the improvement which comprises including in the solution of oxidizing agent 20 to 30 percent by weight of magnesium sulfate.

7. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent selected from the group consisting of soluble ammonium, alkali, and alkaline earth iodates, periodates, and bromates, hydrogen peroxide and urea peroxide, the improvement which comprises including in the solution of oxidizing agent approximately 38 percent by weight of magnesium sulfate.

8. In a process for treating hair to impart a permanent set thereto which includes the steps of treating the hair with a reducing agent for keratin and then treating the hair with an aqueous solution of an oxidizing agent selected from the group consisting of soluble ammonium, alkali, and alkaline earth iodates, periodates, and bromates, hydrogen peroxide and urea peroxide, the improvement which comprises including in the solution of oxidizing agent 20 to 30 percent by weight of magnesium sulfate.
which comprises including in the solution of oxidizing agent approximately 18 to 20 percent by weight of calcium acetate.

9. A hair treating composition which consists essentially of an aqueous solution of sodium bromate and at least 5 percent by weight of magnesium sulfate.

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