The articles which the machine of our invention is especially adapted to plate are nuts for through threaded fastenings, particularly cap nuts used on the studs of automobile wheel hubs for the purpose of securing thereon demountable wheels. These cap nuts are commonly provided with conically tapered or spherical engaging faces of a diameter somewhat exceeding the perimeter of the flat faced portion of the nut. The relative small size of nuts of this character, together with their asymmetrical form, renders them unusually difficult to plate. This, coupled with the quantity production in which they are manufactured, renders individual treatment such as is frequently given articles of large size and less quantity, difficult, cumbersome and slow as carried out by the machines at present known to the art.

Our principal object is to achieve the method and the machine for effectively platting such articles in mass. By this method and machine we aim to attain a uniformity, efficiency and a quality of platting comparable at least, if not equal, to that attained in individual platting of larger articles.

Also we aim to attain a speed of production and an efficiency and an economy existing in degree to the degree to which any of those factors are obtainable by individual treatment of the same articles.

Still further, it is our object to reduce to simplest form the feeding of the articles in mass to the machine, their agitation in mass in their passage through the machine and their removal in mass therefrom, and at the same time, to make the mass platting operation as clean and as neat as possible both as respects the machine and as respects the products treated.

According to our method, we progress the articles through the platting bath in a mass of substantially uniform thickness, of extensive area, preferably only one article deep. This mass we agitate without altering the thickness of the mass, an agitate uniformly throughout substantially the extensive area. We plate the mass throughout its area simultaneously and from a uniform distance, the while maintaining a substantially uniformly distributed and non-agitated plating contact with the article throughout the mass and independently of the progress of the article through the bath and likewise independently of the agitation of the article. We feed the articles to the path over which they are progressed in transverse ranks and at a rate substantially equal to the speed of the articles along the path provided by the depth of the ranks. While passing through the bath, we agitate the articles in mass to subject all sides thereof substantially equally to the platting action, so that they emerge from the bath plated to a substantially uniform thickness. These ranks we maintain in unbroken groups transversely of the path throughout its extent. To facilitate the feed in ranks we feed the articles up-hill to their rank formation by giving them an agitating impetus always in the direction of the path through the bath.

The apparatus which we have found to be a component part of our method and which is shown in the accompanying drawings as the best embodiment now known to us, of which Figure 1 is a longitudinal vertical section of the machine at large. Figure 2 is a top plan view of this machine. Figure 3 is a rear end view. Figure 4 is an enlarged cross section of the other end of the machine. Figure 5 is a transverse cross section on line 5—5 of Figure 4, and Figure 1. Figure 6 is a greatly magnified portion of the upper left-hand part of this cross section. Figure 6a is a detail sectional view taken between two adjacent agitator fingers of Fig. 6. Figure 7 is a general three quarters perspective from above of a medial portion of the machine. Figure 8 is a transverse cross section on line 8—8 of Figs. 1 and 2.

A general survey of the drawings will disclose the fact that the machine of our invention comprises a platting bath, an endless travel conveyor, a means for feeding the ar...
ticles in mass in a uniform distribution upon
the said endless belt conveyor, a longitudi-

nally reciprocable agitator for the mass
substantially paralleling the conveyor and uni-
formly distributed over the area of the con-

veyor, cathodes in the form of bars parallel
the path of the conveyor and sub-
merged in the mass of articles carried thereby, and
anodes uniformly distributed over the area
of the conveyor, about it and substantially
uniformly spaced therefrom.

The bath 20 is carried in a tank 31 of elon-
gated form. Within this bath is disposed an
endless conveyor belt 22 the entire body of
which, top and bottom, is submerged. Cylin-
ders 23, the axes of which are supported in
journals carried by the walls of the tank,
carry and drive the conveyor 22. One of the
rollers 23 is longitudinally adjustable with

respect to the other by device 24 from with-
out the tank. The other is driven through the
shaft connection 25 outside of the tank.
The upper reach of the belt 22 is supported
from the side walls of the tank through cylin-
ders 23 mounted on axes supported by the

sides of the tank at points equidistant from the
bottom and therefore maintained in plane and
by a table 26 extending longitudinally therof and secured to the opposite sides of
the tanks and is in substantially level form.
The lower reach of the belt 22 finds support
at intervals upon transverse rollers 27 and
undue sag is therefore avoided. The belt is
preferably of rubber or rubber composition
or other insulating material and itself forms
no part of the electrical circuit of the process.

At the front end at the top of the tank 21
is arranged a transverse measuring device in the
form of a grooved wheel or its equivalent
28. The grooves of this wheel are of suffi-
cient area transversely of the wheel to accom-
modate normally circumferentially but one
nut at a time. Transversely through a length
substantially equal to the width of the con-
veyor belt 22 whereby they may be accommod-
ed in each groove, is a single transversely
extending rank (speaking in military terms)
of nuts. The over-arched relatively fixed
sheathing 29 is affixed to the tank and so jux-
taposed to the periphery of the wheel 28 that
any nuts lodged in the grooves in excess of
the single rank will be dislodged therefrom
by engagement with the advance edge 30 of
the sheathing. An inclined play-way 31 is
extended from the periphery of the wheel 28
on its front side downwardly to a line adja-
cent the front end of the top reach of the belt
22. As the wheel 28 revolves in the direction
of the arrow, the ranks of nuts which may be
carried thereby are delivered one by one
down the way 31 to the face of the belt. By
means of direct shaft connection 32 between
the rear roll 23 and the wheel 28 the delivery,
rank by rank, is effected at a rate equal to the
speed of forward movement of the belt 22
divided by the depth of the rank. Thereby a
uniform distribution of nuts, rank by rank in
contiguity with each other, is effected as the
mass is progressed by the conveyor through
the bath. This uniform distribution sub-
stantially one nut deep is maintained on the
conveyor by transverse partitions 33 also like
the belt 22, made of insulating material at
suitable intervals across the surface. It is
important, however, that the ranks of nuts
are not too closely packed between the trans-
verse partitions, because this would interfere
with the proper action of the agitating
means to be described.

The nuts are delivered or otherwise placed
in bulk upon a feed table 34 in advance of the
feed wheel or measuring device 28. This
table has a slight inclination up hill, sufficient
to prevent any gravity movement of the bulk
toward the measuring wheel 28 and thereby
prevent tendency to clog that wheel. Still
further, this table is pivotally mounted on
35 upon a bracing structure 36 supported from
tank 21 and also pivotally mounted at its
front end on an axis 37 which is maintained
in continuous oscillation by means of an
eccentric drive from motor 38. Thus, the en-
tire table 34 is agitated. Moreover, the rate
of speed of the motor 38, the throw of the e-
centric oscillating axis 37 and the inclination
of the table 34 are altogether so adjusted with
respect to the gravity action on the nuts,
their mass and the other general conditions
of adjustment under agitation upon the table
34 that they always receive from the agita-
tion, a controlling impetus throwing them
slightly upwardly and forwardly toward the
measuring wheel 28 by appropriate degrees.
In other words, with the direction of the ec-
centric as shown by the arrow the forward
and upward impetus of the nuts is sufficient
to clear the advance portion of them at least
from the table 34 on the upward part of the
oscillation of the axis 37, to enable the tabe
to drop from contact with them during the
controlling portion at least of the downward
movement of oscillation, and to resume con-
tact during the upward and forward motion
thereof. This movement not only insures a
shaking down of the bulk initially placed
upon the front end of table 34 to an extensive
mass substantially one deep, but also the feed-
ing of the foremost nuts of the mass so shaken
down into the immediately adjoining area
of the measuring wheel 28. The sheathing
29 is so extended toward the table 34 as to
leave open but one at a time of the feeding or
measuring grooves of the wheel. Suspended
from bus bars 39 arranged transversely of
the top of tank 21 are cathode bars 40. These
bars 40 substantially parallel to the path of
movement of the conveyor through its ex-
tent are uniformly distributed in transversely
spaced relation over its area, and lie in a
plane parallel to the plane of the belt and
closely contiguous thereto, and passed through openings made for them in the transverse bars or partitions 33 on the belt 22. Thereby they are submerged in the uniformly distributed mass of articles being processed along the conveyor belt, and thereby they do not interfere with the progress of the articles along the path, nor agitate them. Rather they assist in confining them to the path of movement and in the retaining of them in orderly rank formation which is necessary for proper plating and agitating action. The outermost of these bars 40 closely adjoins the margins of the conveyor belt 22, thereby, as clearly appears in Fig. 6, constituting a boundary wall assisting in confining the outermost article to the path of movement intended and precluding other interference with the side walls of the tank or with the provided side guides 41 fixed to the side walls for the edges of the belt 22. These cathodes are in the form of iron rods, since the particular material with which the nuts are at present plated by my process is cadmium.

Superimposed in the bath 20 above the conveyor belt a substantial distance but paralleling it and uniformly distributed over its area are a plurality of anode boxes 42 which contain a uniform distribution of anode bars 45 of cadmium. The boxes are of conducting material. Their supports 44 connect with bus bars 45 supported like the bus bars 39 from the upper side walls of tank 20. Both anode and cathode bus bars are, of course, properly insulated from each other and from the tank itself.

Intermediate the uniformly distributed area of anode bars 43 and the uniformly distributed cathode bars 40 is a uniformly distributed system of finger agitators 46. These are composed of rubber or other yielding insulating material downwardly extending and are formed in transverse connected groups 47 as clearly appears in the sections, particularly in Figs. 6 and 6a. The transverse groups 47 of fingers 46 are disposed at intervals throughout the length of the path as are the anode and cathode bars and the transverse partitions 33 on the belt. The fingers are carried commonly by a longitudinally reciprocable frame of channel iron 48 suspended at its ends from the sides of the tank by means of suitable pivoted hangers in such manner as to have an agitating movement longitudinally of the path of movement of the belt 22 and substantially parallel thereto. This movement is supplied by the bell crank mechanism 49 driven from the rear end of shaft 25, through suitable crank and link connections as clearly shown in Figs. 1 and 3. The ends of the fingers uniformly engage the uniformly distributed mass of nuts at a depth appropriately related to the least height which a nut projects above the belt in any given position. The depth of engagement, the cross section of the fingers, their flexibility, and the stroke of reciprocation are so adjusted that the yielding engagement of the ends of the fingers with the nuts is quite sufficient to turn them about from one relative position to another without changing materially their locations on the conveyor belt or piling them upon each other. Thereby the surfaces of the nuts are variously presented, the liquid of the bath is prevented from pocketing, and the plating action is rendered uniform and thorough. To secure uniform plating, frequent turning of the nuts is essential, and of course, this cannot be achieved if they pile up on the belt, or are swept from one space between adjacent portions 33 to an adjacent space. Consequently, with the type of articles, i.e., cap nuts disclosed, the proper height of the transverse partitions 33 is over half the vertical height above the belt of the maximum height of the nut in any given position thereof and the fingers 46 project downwardly into the nuts to a depth slightly lower than the tops of the bars 33. For proper agitation and timing of the nuts, it is necessary that the reciprocation of the agitator finger frame 48 is at a substantially more rapid rate than the movement of the belt so that a given transverse line of fingers may sweep at each reciprocation through the space between adjacent transverse partitions or bars 33. Since the fingers are continuously bent by engagement with the nuts and transverse bars 33 now one way, now another, in every direction, they require to be made of a section best suited to give long life under this severe usage. For the particular type of article here treated, it was found that tapered fingers of generally round cross-section and merging into the base member connecting the transverse groups 47 by rounded surfaces gave the most satisfactory service. It will be noted that the transverse groups 47 may be very economically made as by moulding a single tapered strip of rubber or other yielding insulating material, which is clamped at the top between metal strips 47 to form a unit attached to the agitator frame channel 48 as by bolts to permit its ready removal for replacement or otherwise.

The length of the bath and of the belt, and the rate of progress of the nuts through the bath are all properly coordinated with respect to the rate of plating desired and with respect to the amount of electrical energy utilized in carrying it out. At the rear end of the conveyor belt is arranged a submerged hopper 50 in a position to receive the ranks of nuts as they round the wheel 30 and are drawn by gravity from the face of the belt 22. Into the bottom of this hopper dips a bucket elevator 51 the buckets of which dip up the nuts and elevate them from the bath. They are discharged into a washing appara...
tus 52 down which a stream of water or other washing fluid (not shown) may be played to relieve the nuts of the liquid of the bath. This washing apparatus is in the form of a number of alternating downwardly inclined rubber partitions 53 the bottommost of which discharge the nuts through an opening 54 and from the machine at large. The device 52 may be used entirely as a drainage device, the liquid contained in the cap nuts incident to the tumbling over the inclined ways 53 being drained therefrom and thereby recovered and passed back into the bath 20. The machine at large in its entirety is driven by motor 55 mounted on a pedestal 56. This motor not only drives shaft 25 from which are derived the motions of the conveyor belt wheels 23 and the measuring device 28 and the agitator 33 but also through the belt connection 58 the motion of the bucket elevator 51. Motor 58 drives table 34 independently for reasons of impetus adjustment.

That this apparatus carries out the method of our invention and realizes in full the advantages we have set forth should be clearly apparent from this detailed description thereof. That it is susceptible of many modifications without departing from its generic spirit should be equally perceptible. Such modifications we claim as well as the embodiments disclosed and outlined.

1. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, and a measuring device delivering articles in mass to said conveyor in rows transversely thereof.

2. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, and a measuring device delivering articles in mass to said conveyor in rows transversely thereof and at a rate equal to the speed of the belt divided by the depth of the transverse row.

3. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, and a measuring device delivering articles in mass to said conveyor in rows transversely thereof and at a rate equal to the speed of the belt divided by the depth of the transverse row.

4. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, means for uniformly distributing articles in mass to said conveyor, and an agitator device co-extensive with said conveyor, in area and longitudinally reciprocal substantially parallel to the path of movement thereof.

5. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor in which said conveyor is submerged, means to distribute articles to be plated uniformly over said conveyor during its progress, and agitating means uniformly distributed over the area of the conveyor and having an engagement with the articles to be plated sufficient to turn the articles but insufficient to pile them.

6. A machine for plating articles in mass comprising an endless conveyor belt, a tank containing plating bath in which said belt is submerged, means for uniformly distributing articles in mass to be plated to said conveyor, and relatively fixed cathode bars submerged in the mass of articles in laterally-spaced relation substantially parallel to the path of movement of the conveyor.

7. A machine for plating articles in mass comprising an endless conveyor belt, a tank containing a plating bath in which said belt is submerged, means for uniformly distributing articles to be plated to said conveyor, and relatively fixed cathode bars submerged in the mass of articles in laterally-spaced relation substantially parallel to the path of movement of the conveyor, together with mass-agitating means uniformly distributed over the area of the conveyor and reciprocable with respect thereto.

8. A machine for plating articles in mass comprising an endless belt conveyor, of longitudinally-extending, relatively fixed cathode bars substantially adjoining the margins of said belt conveyor and constituting retaining walls for the massed articles carried by the conveyor, and a tank containing a plating bath in which said belt and bars are submerged.

9. A machine for plating articles in mass comprising a tank an endless belt conveyor, anodes distributed over substantially the entire area of said belt conveyor in a plane substantially parallel thereto, but removed therefrom, relatively fixed cathode bars paralleling the conveyor and in a plane immediately adjoining the plane of the conveyor, uniformly distributed agitating means for the mass of articles carried by the conveyor reciprocable in a plane intermediate the anode and cathode planes, and a plating bath in said tank in which said elements are commonly submerged.

10. A machine for plating articles in mass comprising an endless conveyor belt for the articles to be plated, a tank containing a plating bath in which said conveyor is submerged, and an up-hill mass-feeding device for the articles to be plated agitated to engage the articles fed up hill to the conveyor always in a direction having a principal component toward the conveyor.

11. A machine for plating articles in mass comprising an endless conveyor belt for the articles to be plated, a tank containing a plating bath in which said conveyor is sub-
merged, and an up-hill, mass-feeding device for the articles to be plated agitated to engage the articles fed up hill to the conveyor always in a direction having a principal component toward the conveyor, together with a transverse measuring device receiving the articles from the device and delivering them to the conveyor.

12. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, spaced transverse partitions on the belt, means for delivering a measured quantity of articles in a single layer in the space on the belt between adjacent partitions, and an agitator device substantially co-extensive with the belt, and comprising spaced rows of yielding fingers extending down into the layer of articles on the belt, said agitator device being arranged to be reciprocated in the direction of movement of the belt at a rate of movement more rapid than the movement of the belt.

13. A machine for plating articles in mass comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, transverse partitions on said belt, means for delivering a measured quantity of articles in a single layer in the space between adjacent partitions, and an agitator device substantially co-extensive with the belt and comprising transverse rows of yielding fingers extending down into the layer of articles on the belt, said agitator device having its rows of fingers so spaced with relation to the transverse partition on the belt and being reciprocated in the direction of movement of the belt at a rate of movement with relation to the movement of the belt and through a distance such that a given row of fingers may sweep through the entire space between transverse partitions at each reciprocation.

14. A machine for plating articles in mass, comprising a tank containing a plating bath, an endless belt conveyor submerged in said bath, means for supplying the articles to be plated to the belt in a single layer, transverse partitions on the belt for preventing piling up of the articles, and an agitator device comprising rows of yielding fingers projecting downwardly into the articles so that their lower ends project below the tops of said transverse partitions, and means for reciprocating said agitator device in the direction of movement of the belt.

In testimony whereof they hereunto affix their signatures.

GEORGE L. KELLEY.
CAROLUS L. EKSERGIAN.