This invention relates to an improved method of forming printing surfaces on cylinders. Printing cylinders having intaglio or half tone printing impressions in the surface thereof produced by etching, invariably differ in tonic qualities due to the operator's inability to control the etch. This lack of uniformity is highly objectionable where exact duplicate reproductions are desired, which must be produced from two or more cylinders. Further, much time and great skill is required to manufacture a printing cylinder which will produce satisfactory printing and such printing cylinders are expensive and consequently add greatly to the cost of producing so-called gravure printing.

In accordance with this invention, a printing surface is formed on the cylinder by molding the same from a matrix in which the tonal values of the printing surface are definitely controlled, so that any number of cylinders can be made whose printing surfaces have identically the same printing and tonal values.

An object of this invention is to provide a method of forming printing surfaces on cylinders in which the depth of the tonal values is definitely controlled.

Still another object of my invention is to provide a method for making a printing cylinder having a continuous and jointless printing surface thereon.

Another object of my invention is to provide a method of forming a photographically toned printing surface on a cylinder by which the depth and printing characteristics of the tonal recesses may be definitely and uniformly controlled in a simple, practical and economical manner to provide a printing surface from which a very high quality of printing may be produced.

Other objects of this invention will become apparent as the disclosure proceeds.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which Fig. 1 is a perspective view of a printing cylinder as it appears prior to the application of the printing surface thereon; Fig. 2 shows the printing cylinder mounted on a frame and illustrates one step in the process of forming the printing surface on the cylinder;

Fig. 3 is an enlarged cross sectional view of a fragmentary portion of the printing cylinder, this view illustrating another step in the process of casting the printing surface thereon;

Fig. 4 is a view similar to Fig. 3 and illustrates a further step in the process of casting or molding the printing surface on to the cylinder;

Fig. 5 is an enlarged cross sectional view of a fragmentary portion of the printing cylinder with the printing surface moulded thereon, certain irregularities being shown greatly distorted and enlarged for purposes of illustration; and

Fig. 6 is an enlarged cross-sectional view of a portion of the cylinder showing the integral continuous character of the molded printing surface.

Similar reference characters refer to similar parts throughout the several views of the drawing.

I have shown in Figure 1 a cylinder having a core or body portion 10 which may be formed of metal or any other suitable rigid material. Shaft portions 11 project from each end thereof and are suitably shaped to fit the journals provided therefor in the printing press. A backing layer 12 of suitable material, such as a nitro-cellulose or cellulose acetate composition, covers the core portion 10 of the cylinder. The backing layer may be moulded on to the cylinder in a number of ways. By way of example, the layer 12 may be applied by spraying or painting the backing material on to the core while in a plastic or fluid condition. The cylinder may then be placed in a lathe and cut or ground and polished so as to present a surface perfectly round, continuous and smooth. As a more practical and effective method of coating the cyindrical core 10, the core may be passed through a suitable aperture provided in a vat containing the backing material in semi-liquid condition. Means are provided around the aperture and within the vat for distributing the cellulose material smoothly and evenly around the core. One or more applications may be necessary to obtain the proper thickness. A backing layer of approximately eight one-thousandths of an inch has been found sufficient for effective "rotogravure" printing although the thickness of the layer may be varied within wide limits.

In applying the printing surface to the coated cylinder shown in Figure 1, the cylinder is rotatably mounted in a suitable frame having trunnions 13 in which the shafts 11 rotate. The trunnions 13 are supported on legs or standards 14. A crank 15 may be secured to one end of the shaft 11 for rotating the roll 10 in the trunnions 13, although it will be appreciated that any suit-
able driving apparatus, including necessary gear-
ing, may be made use of.

A copy relief or matrix having a molding sur-
face \( f \) is clamped or secured at one end thereof
against the backing layer 12 of the printing cyl-
der 10. For this purpose one or more adjust-
ably clamping members \( g \) are provided which
grip the end of the copy relief and press it down
against the cylinder. Other well known means
for positioning the end of the copy relief in fixed
relationship to the cylinder may be used, clamp-
ing members \( h \) being shown for illustrative pur-
poses only.

The matrix may comprise a backing sheet \( i \) of
celluloid or other flexible material, and the mold-
ing surface \( j \) may comprise water swollen gel-
atine which has previously been sensitized, ex-
posed and water swollen to form the molding
surface \( j \) in relief thereon. Reference is here
made to my co-pending application, Ser. No.
518,649, filed February 27, 1931. In general such
a relief surface is produced by photographing the
object to be produced and exposing the sensitized
gelatine surface through the photographic plate
carrying the object image. The object image
may be screened with a half tone or intaglio
screen either by exposing the photographic plate
through the screen in the camera, or by exposing
the sensitized gelatine to light passing through
the screen in the printing frame. After exposure,
the screened photographically toned sensitized
gelatine is then immersed in a tank of water,
causing the unexposed portions of the gelatine
to swell and form a relief surface carrying the
screened image in reverse thereon. A water swol-
en gelatine copy relief is thus produced which
carries the photographically toned image in mi-
nute detail. The half tone or intaglio screen
need not be used if unscreened images are de-
sired. It is also understood that, if desired, a
portion only of the subject to be printed may be
screened by subjecting corresponding selected
portions of the sensitized gelatine to the action
of the half tone screen, leaving other portions
of the gelatine unscreened. While the water swol-
en gelatine copy relief just described provides
an excellent matrix carrying the finest image
detail, it is understood that other relief mat-
erials may be used in the casting process herein
described. The printing circumference of the
cylinder is sufficient in size to receive the full
printing impression to be reproduced. The ends
of the copy relief matrix may be provided with
a margin, border or trim \( \ell \) to provide a smooth-
non-printing marginal section \( \ell \) extending lon-
gitudinally across the cylinder adjacent the meet-
ing ends of the matrix.

Compositions which have given eminently satis-
factory results in actual service have been
formed from a cellulose base reduced to a vis-
cous, plastic state by a suitable solvent or solvents.
More particularly, such a composition may be
made by dissolving nitro-cellulose or cellulose ace-
tate in a suitable solvent such as acetone, ethyl
acetate, butyl acetate, amyl acetate, butyl alco-
hol and similar well known solvents in commer-
cial use. In order to get a plastic which will flow
at the desired rate for molding purposes when a
particular solvent is used and to obtain a liquid
composition containing between 20% to 50% or
more, it is preferable to use a mixture of cel-
ulosic bases. A plasticizer may be added but a
plasticizer should be selected which will not ma-
terially decrease the hardness of the finished
product. Preferred plasticizers for cellulose ni-
trate are tricresyl phosphate, triphenyl phosphate,
or dibutyl phthalate, and for the cellulose ace-
tate \( f \) and that triacetin is a satisfactory plastic-
izer. These plasticizers, when used in the small
amounts needed, appear to have very little effect
on the printing quality of the finished material and
give the material the desired plasticity and tough-
ness. These improved cellulosic compositions are
peculiarly adapted for the purposes of the pres-
ent invention in that the compositions give a hard,
resilient and tough plastic mold which wears
well and which will receive and retain the finest
impressions under conditions of use. Various
resins rendered plastic by suitable solvents so
that they can be molded in a relatively cold con-
dition may also be used. It is understood that
various materials initially moldable and adapted
to take the impressions from the copy relief and
maintain the same upon solidification are en-
compassed within the term plasticized material or
moldable composition.

The backing layer 12 should be formed of a
composition which readily adheres to the cylin-
der and also form a strong bond to immutably
secure the printing surface \( k \) to the cylinder.
When a cellulose printing surface \( k \) is used the
backing layer 12 may also be formed of cellulosic
material, and where a moldable resin is used as
the printing surface, the backing layer \( 1 \) may
likewise be formed from material having a resin-
ous base. In moulding the composition \( i \) which
is to form the printing surface on to the cylin-
der, the composition, in a plastic, semi-fluid vis-
cous state, is poured on the cylinder in the posi-
tion shown in Figure 2, and the cylinder is rotated
as the cylinder is rotated. A pressure roller \( 2 \)
mounted to rotate in a journal \( 22 \) provided at the
upper end of an arm \( 21 \) of a pair of bell crank
levers fulcrumed at \( 23 \) to the standard \( 14 \).

To regulate the pressure exerted by the roller
against the copy relief, a weight arm \( 24 \), ex-
tending from each of the arms \( 22 \), is provided.
A weight \( 25 \) rides on each of the arms \( 24 \) and
the pressure exerted by the roller \( 20 \) can be regu-
lated by adjusting the position of the weight.
A quantity of the moldable mass \( 19 \) is placed in
place made quickly and economically in ad-
vance of the molding face of the copy relief
or matrix. Thereafter, the weight \( 25 \) is so ad-
justed on the arm \( 24 \) as to cause the roller \( 20 \)
to bear against the matrix with desired pressure,
forcing the relief surface \( 17 \) of the copy relief
into the moldable mass. Upon rotation of the
cylinder, the mass is spread over the backing
layer \( 12 \) of the cylinder and a moulding of the
mass to conform to the relief is effected.

The roller \( 20 \) is preferably laterally offset with
direction to the vertical so that the moldable ma-
terial \( 19 \) will remain in position on top of the
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plasticized mass 19 is squeegeed or forced by the pressure roller 20 up onto the non-sticking gelatine strip 30, if any excess be present. The material 19 is forced up against the end edge of the molding backing 18 and the relief surface 17, and in so doing a little of the 25 plastic mass is squeegeed or forced by the pressure roller 20, substantially of knife-like fineness, may be forced which extends longitudinally across the roll.

When the printing surface 18a has been completely formed, the surface is permitted to harden and set, which requires approximately 10 to 30 minutes when a moldable cellulosic mass is used. The time element will, of course, vary with the moldable material used. When the printing surface 18a has set to a sufficient degree, the pressure roll 20 is lifted off from the matrix by means of a handle 26. The matrix 16 is then stripped from the roll. The fin 18b, formed by the above method, is so small and fine that no difficulties are encountered with respect to its removal.

The printing surface 18a, as illustrated in the drawing, may be considered an intaglio printing surface, but it is readily understood that a half tone or relief printing surface screened, un-screened, or only partly screened, may be molded from a matrix corresponding to a press plate prepared. When completed the printing surface 18a and the non-printing surface 18b is continuous and unbroken, since the meeting ends of the moldable mass 18 become merged and flow together while the mass is still plastic, resulting in a molded layer free from any seam or joint. The cylindrical printing surface is thus formed in situ, in one operation and without the application of heat. The resulting composite printing cylinder comprises a metallic body, a backing layer formed from a proper surface level, and a superimposed initially cold plastic composition which during the conforming process has also had imparted thereto a desired printing surface. The particular method and apparatus herein disclosed has been found to give excellent results in service. The printing cylinder may be reused by regrinding the cylinder to smoothness or removing the composition with a suitable solvent. When the printing surface is composed of cellulosic material, amyl acetate solvent may be used to remove the same. A new printing surface may then be applied by the method described, or the new printing surface may be superposed on the original printing surface, depending on the thickness of the roll desired.

While certain novel features of the invention have been described and are pointed out in the annexed claims, it will be understood that various modifications of the basic process of forming printing surfaces on cylinders including attaching one end of a copy relief to a backing, and thereafter rolling said copy relief over and upon said cylinder so as to force out the excess plastic and mold the printing impressions carried by said copy relief in the plastic composition retained upon the cylinder.

2. The improved process of forming printing surfaces from cellulosic plastics, including attaching one end of a copy relief to a backing, placing a cold-plasticized cellulosic composition on said backing and in advance of said copy relief, and thereafter rolling said copy relief over and upon said backing, whereby to force out excess plastic and impart the desired printing surface to the material retained upon the backing, and thereafter removing the copy relief from the so formed printing surface.

3. An improved method of forming cylindrical printing surfaces including forming a cellulosic backing upon the surface of a cylinder, positioning one end of a copy relief strip against the surface of said cylinder, placing a predetermined mass of a cold-plasticized cellulosic composition on said cylinder and in advance of said copy relief, and thereafter pressure-rolling said copy relief on said cylinder and said plastic composition whereby a squeegeed between the backing and the copy relief so as to mold the printing impressions carried by said copy relief in the plasticized composition retained upon the cylinder, stripping off the said copy relief from the finished surface, and removing the fin formed at the meeting ends of the copy relief.

4. An improved method of forming printing surfaces on cylinders including, securing one end of a copy relief strip to said cylinder with the impression side of said strip adjacent the cylinder, placing a mass of plasticized cellulosic material on said cylinder and in advance of said copy relief on said cylinder whereby said plasticizing material is squeegeed between the cylinder and the copy relief, forced into intimate adhering contact with the cylinder, and molded by the copy relief, stripping off the said copy relief from the finished surface, and removing the fin formed at the meeting ends of the copy relief.

5. The Improved process of forming printing surfaces on cylinders including, providing a copy relief having printing impressions in reverse in the surface thereof, placing a mass of plasticized cellulosic material on said cylinder and in advance of said copy relief on said cylinder whereby said plasticizing material is squeegeed between the cylinder and the copy relief, and the cylinder to be treated, rolling said cylinder and copy relief together so as to force out the excess plasticized material therebetween and mold the desired printing impressions in the plasticized material retained upon the cylinder.

6. The improved process of forming printing surfaces on cylinders including, providing a copy relief having printing impressions in reverse in the surface thereof, placing a plasticized composition on said cylinder in advance of said copy relief, and thereafter rolling said copy relief over and upon said cylinder so as to force out the excess plasticized material and impart the desired printing surface to the material retained upon the cylinder and removing the fin formed in the plastic composition at the meeting ends of the copy relief.

7. An improved method of forming cylindrical printing surfaces including, providing a copy relief having printing impressions in reverse in the surface thereof, imposing a predetermined mass of plasticized cellulosic material upon said cylinder and in advance of said copy relief, and thereafter rolling said copy relief on said cylinder and said plastic material, whereby said material is squeegeed between the backing surface and the copy relief surface and forced into intimate contact with the backing surface and
molded with the impressions carried by said copy relief.

8. An improved method of forming a cylindrical printing surface including, providing a copy relief having embossed impressions therein, placing a plasticized cellulosic material between the embossed side of said copy relief and the cylinder to be treated, rolling said cylinder and copy relief together whereby the plasticized material is squeezed between the cylinder and the copy relief surface, forced into intimate adhering contact with the cylinder and embossed by the copy relief, stripping off the said copy relief from the finished surface, and removing the fin formed at the meeting ends of the copy relief.

9. An improved method of forming cylindrical printing surfaces including, forming a backing layer upon the surface of a cylinder, fixing an end of a copy relief strip to the cylinder surface, imposing a mass of plastic material on said cylinder and in advance of said copy relief, and thereafter pressure rolling said copy relief on said cylinder and said plastic material so as to mold the printing impressions carried by said copy relief in the plastic material retained upon the cylinder.

10. The improved process of molding a printing surface on a cylinder including, providing a water swollen gelatin copy relief having photographically toned printing impressions in reverse in the surface thereof, placing a moldable material on said cylinder in advance of said copy relief, and thereafter rolling said cylinder and copy relief together so as to mold the printing impressions carried by said copy relief in the moldable material retained upon the cylinder.

OSWALD R. SCHULTZ.