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3,081,206 PRESS ROLLER, AND METHOD OF PRODUCING SAME

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This invention relates to rollers used in printing presses. While primarily useful as inking rollers in offset printing and impression rollers in rotogravure printing, the rollers of this invention may, to some degree, be advantageously employed elsewhere in printing presses.

In the printing process, certain difficulties have been encountered due to friction and static electrical charges. The problems arising from such factors are particularly bothersome in the transfer of ink from a reservoir to a printing blanket in offset printing and the transfer of ink from cylinder to a paper web in rotogravure printing.

In the ordinary printing press, the ink is placed in a reservoir or fountain and is conducted therefrom to the printing surface by means of rollers. Some of these rollers are normally rubber-coated and others are made of uncoated metal. This invention, insofar as it relates to inking rollers, is concerned solely with those rollers which are normally rubber-coated.

As the rollers contact one another and oscillate one upon the other, friction is generated which causes certain difficulties resulting in poor printing and costly roller damage.

Two types of friction, static and kinetic, result from the action of the rollers upon one another, or upon another material, such as ink, in contact therewith. Static friction generates heat and electrical charges. Kinetic friction causes surface wear.

The heat and electrical charges generated by static friction cannot be dissipated by ordinary inking rollers which are dielectric; thus, when two such rollers contact one another the electrical charge of each attempts to transfer itself to the other. An electric arcing may result when two rollers contact one another, and such arcing may cause the elastic filament of the ink to rupture, causing the ink to "back-track" and "mist."

Back-tracking of ink occurs when the ink pigment separates from the ink vehicle. The freed pigment is repelled by negatively-charged inking rollers, and back-tracks through the inking system, redepositing itself in the fountain or reservoir.

The misting of ink also occurs when the pigment separates from the ink vehicle. The pigment separated from the vehicle tends to fly from the inking roller and printing blanket causing a mist.

It is believed that at least some of the kinetic friction generated by the action of the rollers upon one another is a result of the electrokinetic or zeta potential of the rollers.

It is believed that most materials have a surface film of water. According to electro-kinetic theory, when two substances, such as water and rubber are brought into contact, there is an adsorption of ions from the water onto the rubber surface, setting up what is known as a Helmholtz electric double layer.

The migration of the ions from the water to the rubber, results in a layer of negative charges in water firmly fixed to the rubber surface, and an adjacent layer of positive charges lying in the water beyond the layer of negative charges and movable with the water. The electrokinetic or zeta potential is the potential between these two layers. Since such potential exists, and since the charges are immediately adjacent to one another, there is an attraction between the rubber and the water and they are held together quite firmly at the surface of the rubber.

It is believed that inking rollers adsorb a certain

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amount of ink on their surface during the course of normal operation. I believe that such ink forms a Helmholtz double layer on the surface of the inking rollers, and in respect to ordinary inking rollers, the surface of the inking roller has an electrokinetic potential with respect to the ink.

Since in normal operation inking rollers are constantly in contact one with another, the ink film becomes common to two rollers at their point of contact, thus tending to bond together the two rollers, due to the electrokinetic potential between the rollers and the ink film common to both of them.

Ordinary rollers are not treated in any manner to counteract the generation of kinetic friction, and are subject to glazing, pitting and wear.

In rotogravure printing a web is coursed between a nip taken in an impression roller, which is coated with a resilient coating, such as rubber, and an etched rotogravure cylinder. The rotogravure cylinder, which is coated with ink, transfers the image to the web, the impression roller acting as a support for the web to allow the image to be transferred thereto.

Static friction is caused as the web travels at high speed through the press machinery, and such friction generates static electrical charges on the web. When the web consists of newsprint, or other types of uncoated paper, loose surface fibers, which are normally arranged parallel to the surface of the web, are caused to assume a position perpendicular to the surface of the web. However, when the static electrical charge is removed from such a web, the fibers will reassume a position parallel to the surface thereof.

When a web whose surface fibers are arranged perpendicularly to the surface thereof comes in contact with a rotogravure cylinder, "wicking," a printing imperfection, may result.

Wicking is characterized by areas of the web which should be uniformly printed upon being devoid of ink in small areas. As the free end of a fiber which is perpendicularly arranged from the surface of the web contacts a rotogravure cylinder, the fiber acts as a wick, and conducts the ink from a small area of the cylinder. When the cylinder contacts the web, that area from which the ink has been removed by the fiber is dry, and so cannot transfer an image to the web.

Ordinary impression rollers, being dielectric, cannot conduct the static electrical charges from the web. Impression rollers which are made in accordance with this invention are electrically-conductive, and when equipped with a proper ground, allow the electrical charge from the web to be dissipated.

Kinetic friction is generated by the action of the web over the impression roller. It is believed that the web has a surface film of water which is not ordinarily apparent. The impression roller adsorbs a given amount of the water film, and a Helmholtz electric double layer is formed in the same manner as on the inking rollers.

This kinetic friction causes the surface of ordinary impression rollers to glaze, pit and wear. When an impression roller becomes glazed or pitted, or has become quite worn, the press must be shut down while the roller is replaced.

The general object of this invention is to provide press rollers which overcome the difficulties encountered with ordinary press rollers by providing press rollers which will dissipate heat and electrical charges, and which possess properties to prevent the generation of kinetic friction.

A more specific object of this invention is to provide electrically-conductive, non-friction press rollers.

Another object of this invention is to provide a method of producing such rollers.

Other objects and advantages of the invention will more fully appear from the following description.

Since my invention resides in large part in the properties and characteristics of the coating material of the press rollers, and since the art of making rubber-covered rollers is quite old, I do not deem it necessary to explain in detail the physical structure or mechanical method of manufacture of the rollers. Rather, I shall explain the formulations and process for compounding the press rollers of my invention.

The surface of press rollers is preferably composed of some oil-resistant compound, since such rollers are constantly in close proximity to printing inks which are formulated with pigments in either an oil or an oil varnish vehicle. Were a compound which was not oil-resistant used as a surface coating for press rollers, the coating, were it to be covered with ink, would enlarge or expand, giving rise to new difficulties. It is especially important that inking rollers have an oil-resistant coating, since normally they are constantly coated with ink.

It has been discovered through experimentation that certain rubber and plastic polymers are oil-resistant and well suited for use as a base compound in the manufacture of coatings for electrically-conductive press rollers. Examples of such compounds are: "Teflon;" silicone; neoprene; nylon; irradiated polyethylene; butyl rubber; natural rubber; "Hypalon" rubber; chlorinated rubber; and iso-cyanides, such as "Vulcollon."

Since the coatings of press rollers are mold-cured upon a mandrel, and since rubber and plastic polymers should be in a liquid state for mold pouring, natural rubber, when employed as a base compound, is first depolymerized by mechanical and chemical peptization. In the process of depolymerizing rubber, a certain amount of oil is added thereto to make it flowable.

As is the case in most rubber products, fillers and pigments are added thereto in order that the rubber will assume those qualities, such as density or hardness, which are desired for the specific application for which the rubber is to be employed.

In the case of this invention, the pigments added to the base compound are responsible for the electrical conductivity of the compound, and hence the type of pigment is critical. Those pigments which are suited for use in the manufacture of the roller coatings of my invention include: carbon blacks, acetylene black, super abrasion furnace blacks, channel blacks and graphite. Of these pigments, acetylene black is ideally suited for use in the rollers of this invention, because its spatial network coincides remarkably well with the spatial network of the base compounds with which it is formulated.

In order for the pigments to lend the qualities above referred to to the base compound with which they are formulated, it is necessary that they be dispersed evenly throughout the base compound. When the above-mentioned pigments are to be used with depolymerized rubber, these pigments must be suitably prepared in order to assure their dispersion therein, due to the fact that these pigments are not naturally hydrophobic, and depolymerized rubber contains a certain amount of oil which is necessarily added thereto to make it flowable.

It is possible to coat the pigments with a hydrophobic film, and thus assure their uniform dispersion in depolymerized rubber. One method of doing this is to mill said pigments in a water solution containing a primary hydrogenated tallow amine acetate for about thirty minutes. The pigments absorb the formulation and a hydrophobic film is formed on the pigment particles.

To impart non-friction properties to the rollers, and thus overcome the effects of kinetic friction, mica, graphite or molybdenum disulphide may be added thereto.

The compound, comprising rubber or plastic polymers together with the fillers and pigments, is preferably vulcanized by peroxide rather than sulphur, since rubber, which has been vulcanized by sulphur is not impervious to

oils and solvents commonly employed in ink vehicles, whereas rubber or plastic which has been vulcanized by peroxide is impervious to these substances.

When sulphur is used as a vulcanizing agent for rubber or plastic, the resulting product consists of molecules of very long chain length with certain cross-linkages extending from one to the other. The long chain molecules are easily broken, as by being subjected to sunlight.

When peroxide is used as a vulcanizing agent for rubber or plastic, the resulting product consists of molecules of shorter chain length and is thus more impervious to oils and solvents and is much more stable, since, as a general rule, the shorter the chain length of a molecule the more stable the molecule.

A peroxide is a compound containing two monovalent or bivalent oxygen atoms joined by a single linkage. When a peroxide is used as a vulcanizing agent, and the compound in which it is used is subjected to heat, the peroxide, being quite unstable, decomposes. The decomposition of the peroxide is characterized by a scission of the peroxide at that point in the molecular structure whereat the oxygen atoms are joined by a single linkage. As a result of the scission, an oxygen radical is formed. The oxygen radical joins with a hydrogen atom, as a free oxygen radical, resulting in the formation of a hydroxyl radical.

The hydroxyl radical which is formed in a manner similar to that described above is very reactive, and tends to combine with other ingredients normally present in the rubber or plastic to form a hydrocarbon radical which, in its simplest form, will combine with another hydrocarbon radical similarly formed to produce a vulcanite wherein the cross-linkage is a direct carbon-to-carbon bond. From experimentation it has been determined that the most satisfactory peroxide vulcanizing agent is di-cumyl peroxide.

The compound, including the base compound, fillers, pigments and vulcanizing agent, is poured over a mandrel which has a mold formed about its center portion. The compound is then cured or vulcanized until it has hardened suitably. It has been found that, as a general rule, the compound will cure or vulcanize in about one hour when subjected to a temperature of approximately 140° C. for that period of time.

Among the formulations which may be used for the purpose of making electrically-conductive, non-friction press rollers, the following examples of compounds which I have used may be given:

Example I

To 75 parts of water 5 parts of an amine acetate such as Rosin Amine (dehydroabie tylamine) and 20 parts of either acetylene black, super abrasion furnace black or graphite are added. The entire mixture is dispersed for one hour in a high-speed colloidal mill. After being subjected to the colloidal mill, the mixture is vacuum dried to remove the water therefrom.

100 parts of a vinyl-modified silicone rubber polymer, such as Vinyl Silicone W-96, made by Linde Air Products Company, 50 parts of a pigment, such as acetylene black, which has been treated as hereinabove described and 2 parts of di-tertiary butyl peroxide are milled together. This mixture is mold cured at a temperature of at least 340° F. under steam pressure equal to at least 110 pounds per square inch.

It should be noted that the parts of the constituents referred to in this and other examples mean parts by weight.

Example II

To 100 parts of Thiokol rubber, a synthetic made from the reaction of sodium polysulfide with a chlorinated hydrocarbon, are added 50 parts of acetylene black which has been treated in the manner described in Example I, and a suitable quantity of tetra-methyl thiuram disulfide to serve as a curing agent. This mixture is milled to

gether on a rubber mill. After milling, the mixture may be mold cured at a temperature of at least 340° F. under a steam pressure equal to at least 110 pounds per square inch.

Example III

To 100 parts of neoprene (2 chloro-1,3 butadiene) are added 2 parts of Neozone A (phenyl alpha-naphthylamine), 4 parts of magnesia, 5 parts of zinc oxide, 10 parts of a hydrocarbon rubber oil, such as Circo light oil, and 50 parts of acetylene black. The mixture is milled together on a cold rubber mill. After milling, the mixture may be mold cured at a temperature of at least 287° F. and under steam pressure equal, at least, to 110 pounds per square inch.

Example IV

To 100 parts of a synthetic rubber such as Butyl rubber (vulcanizable hydrocarbon polymer of low unsaturation) are added 2 parts of Neozone A, 4 parts magnesia, 5 parts zinc oxide, 10 parts of a hydrocarbon rubber oil and 50 parts of acetylene black. After milling, the mixture may be mold cured at a temperature of at least 340° F. and under a steam pressure equal at least to 110 pounds per square inch.

By employing the press rollers of my invention many advantageous results may be realized, among them are: less time need be devoted to cleaning the press room, since ink misting is eliminated; the presses may be operated for a longer period of time without being torn down to replace press rollers, since press rollers made in accordance with my invention do not wear out, pit or glaze as readily as ordinary rollers; the ink transfer from one inking roller to another, when both rollers are made in accordance with my invention, is more uniform than is the case when ordinary rollers are employed; and improved printing results may be obtained, since wicking of the ink is eliminated.

Since certain changes and variations may of course be made in the structures, compositions and procedures above-described without departing from the principles and scope of the invention, it is intended that the foregoing specification shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A printing press roller comprising a mandrel and a smooth, impervious surface covering thereon of resilient rubber-like material having oil-resistant properties, such surface covering being made from a composition having acetylene black uniformly dispersed therein to render it electrically conductive and molybdenum disulphide incorporated therein to impart non-friction properties thereto.

2. A printing press roller comprising a mandrel and smooth impervious surface covering bonded thereto, said covering being made of a resilient rubber-like base material having oil-resistant properties, said base material having uniformly dispersed therein an electrically-conductive pigment material, taken from the group consisting of acetylene black, carbon blacks, super abrasion fur-

nace blacks and channel blacks, in sufficient amount to render said surface covering electrically conductive, whereby it will dissipate static electrical charges from paper webs contacting the roller, said base material also having uniformly dispersed therein a material taken from the group consisting of molybdenum disulphide, mica and graphite, to impart non-friction properties to said surface covering, whereby the generation of static and kinetic friction in the normal operation of the roller will be avoided.

3. A method of producing a printing press roller comprising a mandrel with a smooth, impervious electrically conductive covering thereon, which consists in applying a hydrophobic film to pigments taken from the class consisting of acetylene black, carbon black and super abrasion furnace blacks, by mixing such pigments in a water solution containing an amine acetate selected from the group consisting of primary hydrogenated tallow amine acetate and dehydroabietylamine, removing said pigments from the water solution, drying the pigments preparing a compound containing such pigments and depolymerized rubber with the pigment particles uniformly dispersed in such depolymerized rubber, and applying said compound to said mandrel in firmly bonded relationship to form said surface covering.

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