NOVEL WEAR-RESISTANT LASER-ENGRAVED CERAMIC OR METALLIC CARBIDE SURFACES FOR FRICTION ROLLS FOR WORKING ELONGATE MEMBERS, METHOD FOR PRODUCING SAME AND METHOD FOR WORKING ELONGATE MEMBERS USING THE NOVEL FRICTION ROLL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to friction rolls for elongate members, e.g., webs or strands such as those used in the textile, paper or steel industries and more particularly refers to friction rolls for webs or strands, e.g., crimper rolls, draw rolls, yarn package drive rolls, guide pins, friction pins, etc. having laser-engraved surfaces that are wear-resistant and that are adapted to readily and quickly grip the web or strand being moved and to quickly and completely release the web or strand after it has passed the roll.

2. Prior Art

In the textile industry, exceptional effort has been expended and is continuing to be expended towards the development of friction rolls having surfaces suitable for driving or working on yarns, strands, filaments or webs at relatively high speeds. Much of this work has been directed to the modification of the roll surface to render it more adaptable to gripping the yarn, filament, strand or web quickly and readily and then releasing it quickly and readily after it has moved past the roll. For example, U.S. Pat. No. 2,863,175 describes the problems of "lapping-up" and "eyebrowing" and describes the numerous attempts at using sleeve-like roll covers known as cots in efforts to overcome the lapping-up and eyebrowing problems. For example, leather cots have previously been tried as well as cots made of synthetic materials which show considerably longer life than leather. In spite of these efforts, the lapping-up and eyebrowing problems persisted as well as the short life for the roll surface, i.e., the cot.

U.S. Pat. No. 3,902,234 embeds finely divided catalyst particles in the interstices of a yarn contacting surface such as are used on yarn-carrying rollers. In addition, U.S. Pat. No. 2,373,876 proposed the addition of graphite to synthetic rubber-like compositions for textile roll surfaces. Another patent, U.S. Pat. No. 2,386,583, proposed the use of rubber particles having a hardness greater than that of the main rubber body of the roll. Cots made of fibrous materials are disclosed in U.S. Pat. No. 2,393,953. Furthermore, materials such as cork within rubber-like compositions are disclosed in U.S. Pat. Nos. 2,450,409 and 2,450,410.

U.S. Pat. 2,863,175 discloses the embedding of frangible particles throughout a rubber-like composition adapted to be used as a roll cover. Thereafter, the surface of the rubber cover is subjected to a grinding action to break the frangible particles to leave a plurality of cavities or voids in the surface of the unit. Obviously, the voids or cavities thus formed are randomly located on the surface of the cot because of the random dispersion of the frangible particles within the rubber composition and the surface of the cot lacks any pattern of cavities or voids. More recently, U.S. Pat. No. 4,547,936 proposes the use of rolls which have a resilient covering of highly flexible steel wires extending radially. None of the above efforts have met with substantial success in completely overcoming the eyebrowing, lapping-up, and short life problems encountered in high speed textile operations.

In recent years, textile rolls have been provided with chromia, alumina, mixtures of alumina and titania, or mixtures of chromia and alumina coatings to provide wear-resistance. These coatings have met with some success but are subject to rapid wear or corrosion when subjected to even low or moderate corrosive conditions such as could be encountered in a textile plant if the fiber contains an antistatic material, for example, or if the fiber or yarn is still wet or damp from a previous treatment. Comparable friction rolls having metallic carbide surfaces have been tried but, because of the coefficient of friction conditions of such coating surfaces, the yarn, fiber or web was not quickly and readily gripped and then quickly and readily released by the roll except for crimp rolls and thus found little or no use except as crimp rolls.

U.S. Pat. No. 4,322,600 discloses a sheet steel rolling mill roll having a predetermined pattern laser-formed of microcavities on its surface for the purpose of endowing the thin steel sheet being rolled with a suitable morphology for improving its deep-drawing properties as a result of contact with the rolls. The microcavities, however, are formed in the steel surface of the rolling mill roll and there is no disclosure or suggestion of providing a friction roll having a laser-engraved ceramic or metallic carbide coating on it.

Transfer rolls for transferring ink or other medium to a printing roll or directly to material being printed or treated have been made with a ceramic coating and provided with a pattern of laser-formed depressions. Transfer rolls of this type are utilized for transferring ink or other materials and are therefore not subjected to any substantial tensioning, crumpling, stressing or bending forces. Therefore, transfer rolls are generally made of hollow parts to reduce cost and weight. Transfer rolls of this type, because of their lack of tensile and compressive strength, are not suitable for use as crimper rolls. An example of transfer rolls of this type is described in U.K. patent application GB No. 2049102A. Other types of laser-engraved, chromia-coated, transfer rolls have long been made, sold and used in the United States and elsewhere.

None of the prior art disclosed above or known discloses web- or strand-handling friction rolls, or friction rolls that work, e.g., stretch, tension, crimp, surface-modify elongate members, or perform any other work on the elongate members, wherein said friction rolls have a structure and a ceramic or metallic carbide coating bonded to the cylindrical external working surface of the roll and a pattern of laser-formed depressions in the ceramic or metallic carbide coating.

SUMMARY OF THE INVENTION

The present invention is based upon the unexpected finding that web or strand friction rolls having a ceramic or metallic carbide coating bonded to the exterior working surface thereof and a pattern of a plurality of laser-formed depressions covering substantially the entire working surface of said coating provides a uniform, wear-resistant working surface texture which will quickly and readily grip the strand or web contacting the working surface, such as, in draw rolls or mating crimp rolls, and then quickly and readily release the strand or web when it passes out of contact with the working surface. The unexpected quick release feature