

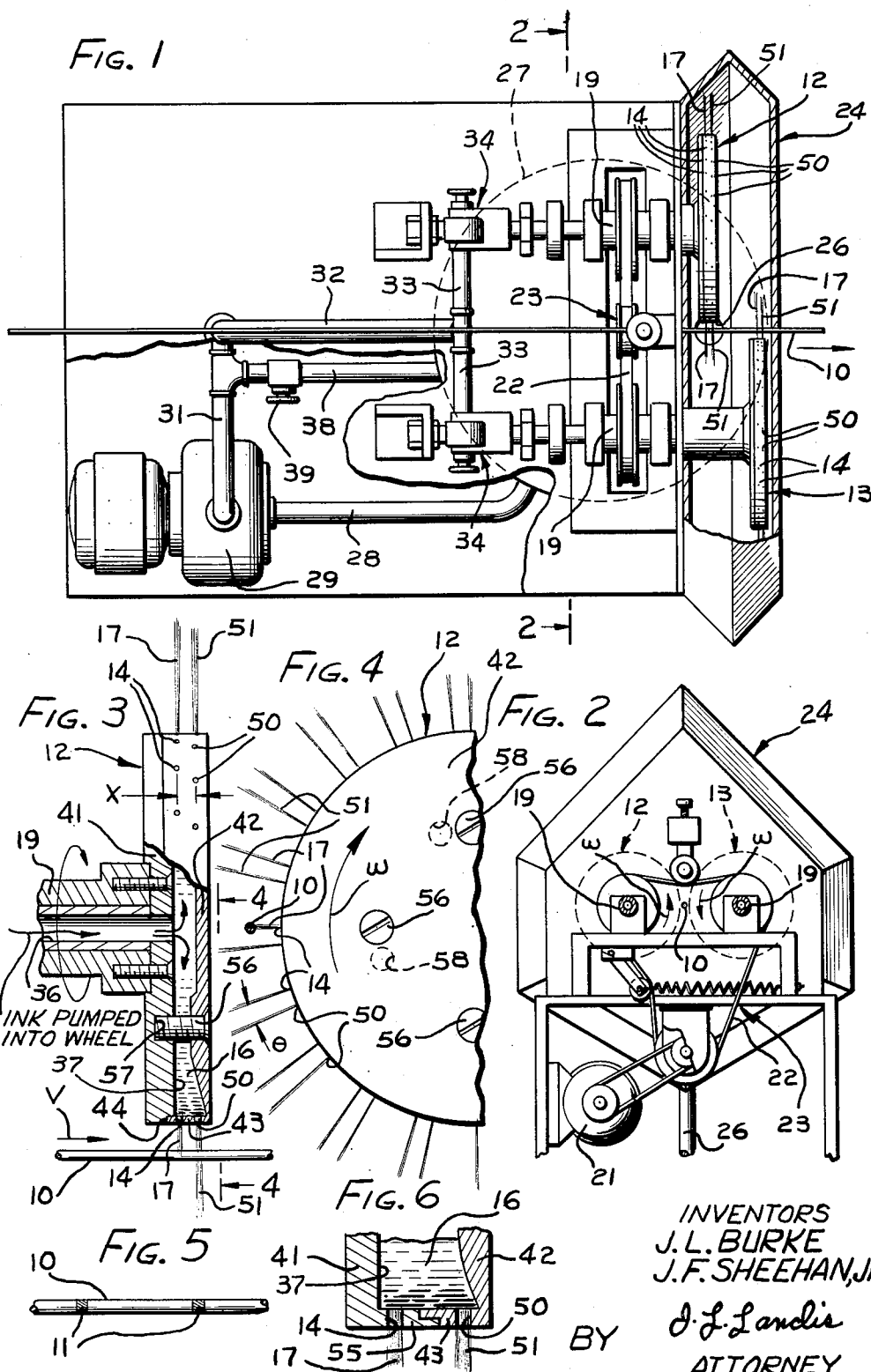
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APPARATUS FOR MARKING ARTICLES WITH A LIQUID

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APPARATUS FOR MARKING ARTICLES
WITH A LIQUID

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The present invention relates generally to apparatus for marking an advancing elongated article with a liquid at spaced intervals along the length thereof, and more particularly to an improved apparatus for color coding an advancing insulated wire for identification purposes.

Accordingly, the general object of the invention is to provide improved apparatus for marking an advancing elongated article with a liquid at spaced intervals along the length thereof, especially for color coding an advancing insulated wire with marks of colored ink at intervals along the length thereof for purposes of identification.

In W. L. Hoff Patent 2,865,323, which was reissued as Patent Re. 24,923 on January 17, 1961, there is disclosed an apparatus for color coding an advancing insulated wire, featuring a pair of hollow rotary wheels mounted on opposite sides of the advancing wire in axially spaced relationship to each other. Each wheel is provided with an identical group of spaced peripheral apertures through which a liquid marking ink is forced, as by pumping, to form radiating streams of ink which intermittently impinge upon the advancing wire at spaced intervals along the length thereof to mark the wire from opposite sides. The wheels are rotated at the same speed and are angularly oriented so that streams of ink from the two wheels impinge upon the advancing wire at the same points therealong from opposite sides thereof so as to form continuous bands of color at the spaced intervals along the wire. In operating color-coding apparatus of this character, it sometimes occurs that the marking is rather faint, particularly with white and yellow ink.

Accordingly, one specific object of the invention is to provide an improved color-coding apparatus of the Hoff type wherein each marked point along the advancing wire will be marked twice so as to provide a stronger, more clearly identifiable marking.

Another problem which is encountered with the use of the Hoff coding apparatus is that from time to time the peripheral apertures in the wheels plug up with ink so that marking points along the wire are missed entirely. According to product specifications, when a certain number of these marking points is missed, the wire becomes defective and must be discarded.

Another specific object of the invention is to provide an improved color-coding apparatus of the Hoff type wherein each point to be marked is marked twice so that substantially longer runs are achieved before a given number of marking points is missed entirely.

With the foregoing and other objects in view, the improved apparatus is particularly characterized in that each hollow rotary marking wheel is provided with a second group of spaced peripheral apertures corresponding in number and in relative spacing with those of the first group. Each aperture in the second group is so displaced axially and angularly with respect to a corresponding aperture in the first group that the stream from each aperture in the second group impinges upon the advancing article at substantially the same point therealong as the stream from the corresponding aperture in the first group, but at a different time. With this construction, the article is normally marked twice at each point therealong to provide a stronger marking and substantially longer runs

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are achieved before any given number of marking points is missed entirely due to plug up of the apertures.

Other objects, advantages and aspects of the invention will be apparent from the following detailed description of specific embodiments thereof, when taken in conjunction with the appended drawings, in which:

FIG. 1 is a top plan view of a color-coding apparatus in accordance with one specific embodiment of the invention, having portions broken away to reveal structural details;

FIG. 2 is a left side view of a portion of the apparatus illustrated in FIG. 1, taken generally along the line 2—2 of FIG. 1 and on a reduced scale;

FIG. 3 is an enlarged top view, partly in central horizontal section, of one of the color-coding wheels illustrated in FIG. 1;

FIG. 4 is a fragmentary side view of the wheel illustrated in FIG. 3, taken generally along the line 4—4 of FIG. 3 in the direction of the arrows;

FIG. 5 is a front view of a color-coded wire produced by the apparatus illustrated in the preceding drawings; and

FIG. 6 is an enlarged fragmentary view similar to a portion of FIG. 3 and illustrating an alternative wheel construction.

Referring now in detail to the drawings and particularly to FIG. 5, an insulated wire 10 which has been color coded in accordance with the invention as shown. While various coding arrangements are used, FIG. 5 illustrates the simplest arrangement, wherein a succession of continuous bands 11—11 of a marking ink, known as "dots," have been applied at regularly spaced intervals along the length of the wire 10. In practice, different wires are color coded in different fashions, having regard to both the background color of the insulation and to the color of the applied marking, so that each wire in a multiconductor cable may readily be identified at any point along the length of the cable. Additional variation may be obtained, as described in the Hoff patents, by making longer markings known as "dashes," and by alternating dots and dashes in a distinctive manner.

The color-coding apparatus illustrated in FIGS. 1 and 2 is substantially the same in general arrangement as that disclosed in the Hoff patents, except for a second row of ink-projecting apertures which are provided at specially arranged points around the periphery of a pair of marking wheels so as to mark each marking point along the wire twice. These features of construction and arrangement will be discussed in detail hereinafter under the heading "The Improved Apparatus."

The Hoff Apparatus

Considering now the general arrangement illustrated in FIGS. 1 and 2, both the Hoff apparatus and the present apparatus include a pair of hollow rotary wheels 12 and 13, which are mounted on opposite sides of the insulated wire 10 for rotation about axes which are parallel to the wire. As viewed in FIG. 1, the wire 10 advances from left to right between the wheels 12 and 13 to receive the markings 11—11. It should be assumed that the wire 10 has just been advanced through a conventional plastics extruder located off the drawing to the left of FIG. 1 whereby the insulation applied, such as polyethylene or polyvinyl chloride, is still relatively hot as the wire 10 advances between the wheels 12 and 13. It should further be assumed that the color-coded insulated wire 10 is ultimately passed to a conventional take-up unit located off the drawing to the right of FIG. 1.

Each of the wheels 12 and 13 includes a group of spaced peripheral apertures 14—14, best illustrated in FIG. 3, through which a liquid marking ink 16 is forced in fine

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radiating streams 17—17 (FIG. 4). Preferably, the apertures 14—14 lie in a common vertical plane which is perpendicular to the advancing wire 10. As the wheels 12 and 13 rotate, the ink streams 17—17 periodically travel across the wire 10 so as to mark the wire at spaced intervals therealong. Preferably, the marking ink 16 contains a volatile solvent so that the ink sets rapidly due to the heated condition of the insulation on the wire 10.

The wheels 12 and 13 are mounted in axially spaced relationship, as illustrated in FIG. 1, so that the ink streams 17—17 from the two wheels intercept the wire at spaced locations and thus do not interfere with each other. The wheels 12 and 13 are mounted on hollow shafts 19—19 of different lengths (to provide the axial spacing just mentioned), and are driven by a variable-speed electric motor 21 through a closed belt 22 of an adjustable drive mechanism designated generally by the numeral 23 at the same speed and in opposite directions as indicated by the arrows in FIG. 2.

The adjustable drive mechanism 23 is described in detail in the Hoff patents, and the chief function thereof is to allow adjustment of the angular orientation between the wheels 12 and 13 so that corresponding ink streams 17—17 from the two wheels impinge upon the advancing wire 10 from opposite sides thereof at the same spaced points along the wire so as to form the continuous color bands 11—11 illustrated in FIG. 5. Thus, each stream 17 from the wheel 12 marks one side of the insulation surfaces of the wire 10 and, shortly thereafter, a corresponding stream 17 from the wheel 13 whips across the wire from the opposite side to complete the dot marking. When dashes are to be made, a group of three to five very closely spaced apertures is used, whereby the dots which would be applied by each merge into a relatively long mark or dash.

The coding wheels 12 and 13 are rotatably mounted within a baffled ink case or housing 24 of the configuration illustrated, which is designed to prevent splashing and loss of ink to the system. The housing 24 is provided with a bottom drain line 26, which returns the excess ink (the overwhelming majority of the ink being projected by the wheels 12 and 13) to a cylindrical tank 27 (FIG. 1) containing a supply of ink. From the bottom of the tank 27, the ink is drawn through a pipe 28 to a motor-driven pump 29, which then forces the ink through pipes 31, 32 and branch pipes 33—33, thence through a pair of seal members 34—34 of the type described in the Hoff patents to interior bores 36—36 (FIG. 3) in the hollow shafts 19—19.

As exemplified in FIG. 3, the ink 16 is pumped through each bore 36 into a cavity 37 defined at the center of each wheel, thence radially outward through the cavity 37 and out through the peripheral apertures 14—14. As viewed in FIG. 1, a bypass pipe 38 is provided at the pump exit to recycle ink to the tank 27, together with an adjustable valve 39 which operates in a well-known manner to govern the amount of ink pumped through the pipe 32 and the branch pipes 33—33 to the wheels 12 and 13.

Referring now to the wheel construction illustrated in FIG. 3, each of the wheels 12 and 13 is formed in two parts, an inner plate 41 which is bolted to the shaft 19 and an outer plate 42 which is secured to the inner plate 41 in spaced relationship thereto. The outer plate 42 is formed with a peripheral flange 43 that fits tightly within a circumferential recess 44 in the inner plate 41 so as to define the cavity 37 through which the ink 16 travels. The peripheral apertures 14—14 are drilled at intervals around the periphery of the flange 43, preferably in a common vertical plane as illustrated.

The width of the ink markings is dependent primarily on the diameter of the apertures 14—14 and, to a lesser extent, on the distance of the wire 10 from the wheels 12 and 13. The rotational speed of the wheels "ω" (r.p.m.) is dependent on the wire speed "V" (feet per minute), the number "n" of apertures 14—14 around the wheel (marks

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per revolution), and the desired frequency "f" of marking (marks per foot) according to the following equation:

$$\omega = \frac{Vf}{n}$$

Thus, assuming that the wire speed is 2500 ft./min., that there are twenty apertures 14—14 spaced equally at 18° intervals around each wheel, and that the desired frequency of marking is 16 marks per foot, then the correct rotational speed may be calculated as 2,000 r.p.m. In practice, this speed is adjusted by controlling the speed of the motor 21 to provide the desired marking frequency based on the wire speed at any time.

The improved apparatus

The improved apparatus is particularly characterized in that each of the coding wheels 12 and 13 is provided with a second group of spaced peripheral apertures 50—50 corresponding both in number and in relative spacing with the apertures 14—14 in the first group previously described. Each aperture 50 in the second group is so displaced axially (dimension X in FIG. 3) and angularly (angle θ in FIG. 4) with respect to a corresponding aperture 14 of the first group that individual streams 51—51 from the apertures 50—50 in the second group impinge upon the advancing wire 10 at substantially the same points therealong as the streams 17—17 from the corresponding apertures 14—14 in the first group, but at a slightly later time.

The axial and angular displacement must be correlated in accordance with the equation

$$X = \frac{12\theta n}{f}$$

where X is the axial displacement in inches, θ is the angular displacement expressed as a fraction of a revolution, n is the number of apertures per revolution of the wheel, and f is the required number of markings per foot. Where X is displaced in the direction of advancement of the wire, θ is measured in the direction opposite to the direction of rotation of the wheel. Thus, in one specific example, using wheels with 20 apertures and a marking frequency of 16 marks per foot as previously described, θ was set equal to 5° (1/72 revolution) and X may be calculated to be 0.208". The absolute values of θ and X are not critical, so long as the above equation is satisfied.

With the wheel construction illustrated in FIG. 3 having both sets of apertures drilled in the flange 43 so that the ratio of X to θ is fixed, it is apparent from the above equation that, while any wire speed can be accommodated with a given set of double apertures by merely changing the wheel speed, different marking frequencies (f) cannot be utilized. This is basically sound for most applications in the telephone industry because the marking frequency f is not changed.

If, however, it were desired to provide a more adaptable wheel capable of handling different marking frequencies, then an alternative wheel construction such as is illustrated in FIG. 6 should be utilized. This construction is the same as is illustrated in FIG. 3, except that the inner plate 41 is provided with a peripheral flange 55 in which the first group of apertures 14—14 is drilled. As in the simpler construction shown in FIG. 3, the second group of apertures 50—50 is drilled in the flange 43 of the outer plate 42, and the two flanges 55 and 43 fit together as indicated so as to prevent leakage of ink.

In order to adjust the wheel for a different marking frequency, a group of screws 56—56 (FIG. 3) that hold the two plates 41 and 42 together is removed from a first group of tapped apertures 57—57 in the inner plate 41, and then the outer plate 42 is rotated with respect to the inner plate 41 to provide a new angle θ corresponding to a different marking frequency f, after which the screws 56—56 are tightened in a second group of tapped apertures 58—58 (FIG. 4) corresponding to the new frequency. For example, if it were desired to color code

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at 24 marks per foot rather than 16 in the example given, the outer plate 42 would be rotated $2\frac{1}{2}^\circ$ in a counterclockwise direction, as viewed in FIG. 4, to increase the angle θ to $7\frac{1}{2}^\circ$ and bring the screws 56—56 into alignment with a second group of apertures 58—58 corresponding to $7\frac{1}{2}^\circ$ displacement of the ink-projecting apertures 14—14 and 50—50.

With the foregoing arrangement of two groups of ink-projecting apertures 14—14 and 50—50, it is apparent that the wire 10 is normally marked twice at each coding point therealong to provide a stronger and more clearly identifiable marking. While this double marking is advantageous with respect to all colors, it is particularly advantageous in the application of white and yellow ink, which colors otherwise do not show up well and tend to be difficult to identify especially on light-colored insulation such as orange.

While this is one important advantage of the invention, another and perhaps more important advantage obtains in that, at such time as any given aperture in any particular group plugs up or otherwise fails to mark the wire, the probability exists that the corresponding aperture in the other group will still be operating so as to mark the wire once at the indicated marking point, whereby substantially longer runs are achieved before any given number of marking points is missed entirely and the wire thus becomes defective.

As an example, consider the simplest case where a wire must be considered defective if any one marking (half of a color band) is missing. Assuming, as previously, that the wire is advancing at the rate of 2500 feet per minute and that there are 20 each of the apertures 14—14 and 50—50 in each of the wheels 12 and 13, there are a total of 40 ink streams 17—17 provided with the Hoff apparatus and a total of 80 streams 17—17 and 51—51 provided with the improved apparatus. Assuming further that a time has been reached when no apertures are already plugged up, but where the apertures are about to plug up in a completely random order at a rate of one every ten minutes for the Hoff apparatus (having 40 ink streams) and therefore at a rate of one every five minutes for the improved apparatus (having 80 ink streams).

Based on the foregoing simplified assumptions, it is apparent that, with the original Hoff apparatus, the average run will be only ten minutes before a marking point is missed, whereby 25,000 feet or 4.7 miles of good conductor will be produced on the average. It will also be apparent that, with the improved apparatus of the present invention, after a first aperture A plugs up at the end of five minutes, the probability is only one in 79 that the corresponding aperture A' will plug up at the end of the next five minutes so as to terminate the run. It can be shown that, by the end of 50 minutes, there is still a 53% chance that no marking point has been missed entirely. Thus, the average run using the double apertured wheels will be better than 50 minutes, whereby in excess of 125,000 feet or 23.7 miles of good wire will be produced before both of the apertures that are provided to mark a particular spot become defective and that marking point is missed entirely.

Thus, in the simple example given, the average output has been increased 400% by the simple expedient of drilling the second, particularly spaced row of apertures 50—50 in each of the wheels. Of course, if more than one mark must be missing before the wire is to be considered defective, the above considerations still apply in general so that substantially long runs are obtained by the use of the invention.

In the manufacture of insulated wire, it is extremely important from a manufacturing standpoint to avoid shut downs in the extrusion line once it has reached operating conditions and is producing good wire. Continuous runs of a great many miles at high speed are produced by automatic changeover between supply and take-up reels. When the line has to be shut down to clean out the cod-

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ing wheels before it is desired to change the color code, a great deal of time is lost and, more important, a considerable amount of faulty wire is produced, both before and after the shut down. As a practical matter, the double apertured coding wheels of the present invention substantially completely eliminate the production of faulty wire due to a missing color code and attendant shut downs because such long runs are achieved that it is substantially always desired to change colors, and start out with clean wheels, before the doubly apertured marking wheels miss sufficient marking points to produce defectively coded wire.

While one specific embodiment of the invention has been described in detail hereinabove, it will be obvious that various modifications may be made from the specific details described without departing from the spirit and scope of the invention. Specifically, while the specific embodiment has been concerned with a pair of offset wheels for color coding insulated wire with encircling bands of color, it is apparent that, in a broader sense, the invention comprehends the use of a single wheel where desired to mark any type of advancing elongated article with any type of liquid at spaced intervals along the length of the article.

What is claimed is:

1. An improved apparatus for marking an advancing elongated article with a liquid at spaced intervals along the length thereof, the marking apparatus being of the general type including at least one hollow rotary wheel having a group of spaced peripheral apertures through which the liquid is forced in radiating streams, the wheel being so positioned with respect to the path of advancement of the article that the streams of liquid impinge upon the advancing article at spaced points therealong; the improved apparatus being characterized in that the wheel is provided with a second group of spaced peripheral apertures corresponding in number and in relative spacing with those of the first group, each aperture in the second group being so displaced axially and angularly with respect to a corresponding aperture in the first group that the stream from each aperture in the second group impinges upon the advancing article at substantially the same point therealong as the stream from the corresponding aperture in the first group but at a different time, whereby the article is normally marked twice at each marking point therealong to provide a stronger marking and substantially longer runs are achieved before any given number of marking points is missed entirely due to plug up of the apertures.

2. An improved apparatus for color coding an advancing insulated wire, the color-coding apparatus being of the general type including a pair of hollow rotary wheels mounted on opposite sides of the wire in axially spaced relationship, each wheel having an identical group of spaced peripheral apertures through which a liquid marking ink is forced in radiating streams which intermittently impinge upon the wire to mark the wire from opposite sides thereof, the wheels being rotated at the same speed and being angularly oriented so that the streams of ink from the two wheels impinge upon the advancing wire from opposite sides thereof at the same spaced points therealong to form continuous bands of color at spaced intervals along the wire; the improved apparatus being characterized in that both wheels are provided with a second group of spaced peripheral apertures corresponding in number and in relative spacing with those of the first group, each aperture in each second group being so displaced axially and angularly with respect to a corresponding aperture in the first group that the stream from each aperture in each second group impinges upon the advancing wire at substantially the same point therealong as the stream from the corresponding aperture in the first group but at a different time, whereby the wire is normally marked twice at each coding point therealong

to provide a stronger marking and substantially longer runs are achieved before any given number of coding points is missed entirely due to plug up of the apertures.

3. An improved apparatus for color coding an advancing insulated wire, the color-coding apparatus being of the general type including at least one hollow rotary wheel mounted for rotation about an axis parallel to the advancing wire and having a group of n equally spaced peripheral apertures through which a liquid marking ink is forced in radiating streams and which lie in a plane perpendicular to the rotational axis, the wheel being spaced from the advancing wire so that the radiating streams of ink intermittently impinge upon the wire to mark the wire at spaced intervals therealong; the improved apparatus being characterized in that the wheel is provided with a second group of n equally spaced peripheral apertures, each aperture in the second group being displaced by an angle θ (expressed as a fraction of a revolution) with respect to a corresponding aperture in the first group and in a direction opposite to the direction of rotation, the apertures in the second group lying in a second plane

which is parallel to the first plane of apertures and is displaced therefrom in the direction of advancement of the wire by a distance X which (in inches) is equal to $12\theta n/f$, where f is a desired marking frequency in marks per foot, the wheel being rotated at a speed ω (in r.p.m.) which is equal to Vf/n , where V is the wire speed (in feet per minute) and f and n are as previously defined.

4. The improved color-coding apparatus according to claim 3, wherein means are provided for adjusting the angular displacement θ in accordance with the equation

$$f = \frac{12\theta n}{X}$$

wherein f , θ , n and X are as defined in claim 3, so as to permit color coding at more than one marking frequency f .

References Cited in the file of this patent

UNITED STATES PATENTS

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