

April 9, 1963

J. G. ROE
PRINTING MACHINE

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2 Sheets-Sheet 1

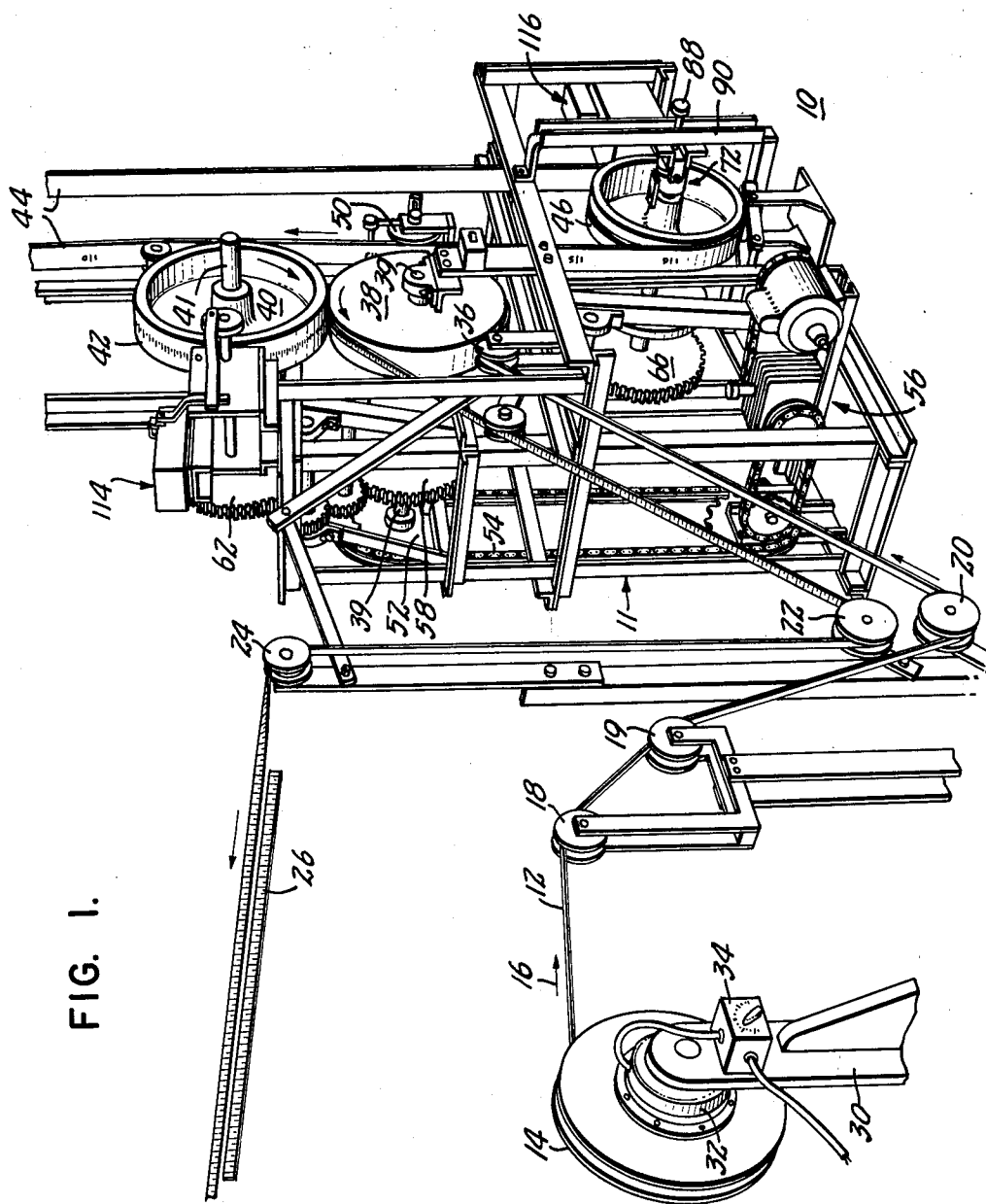


FIG. 1.

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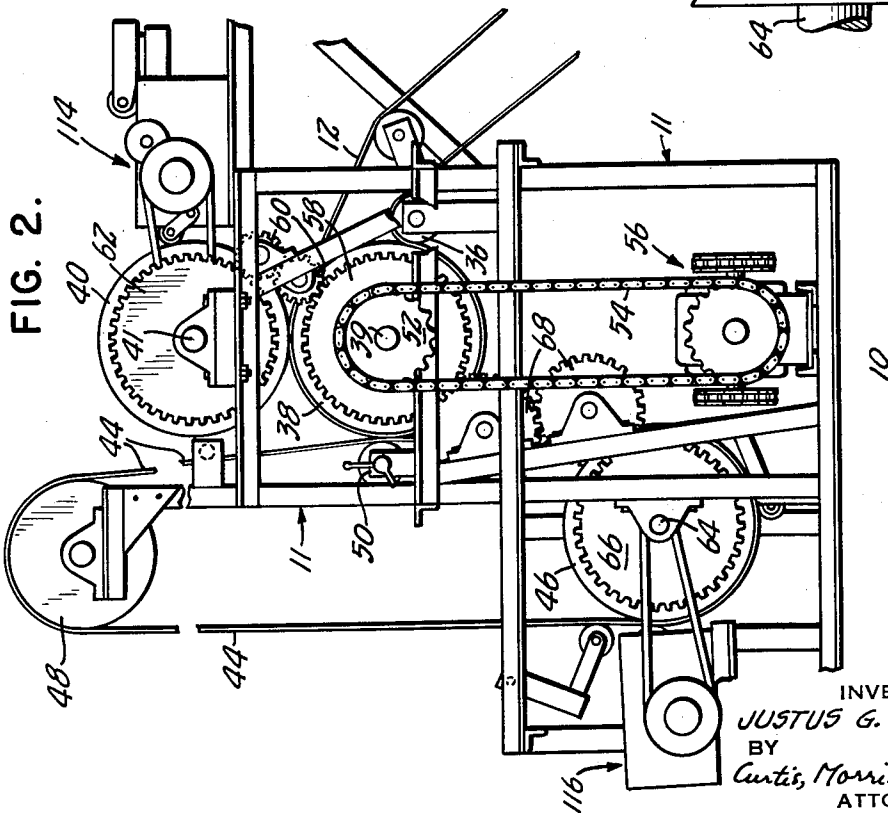
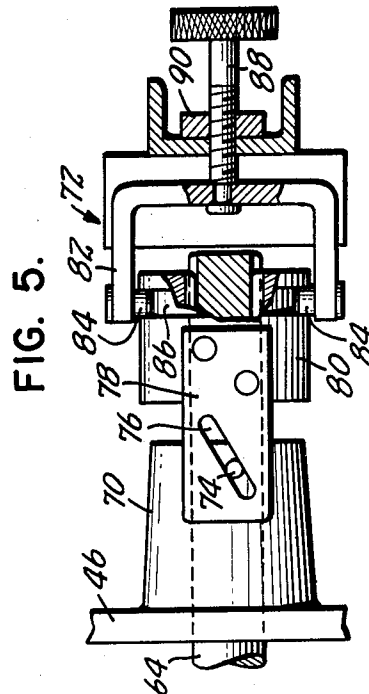
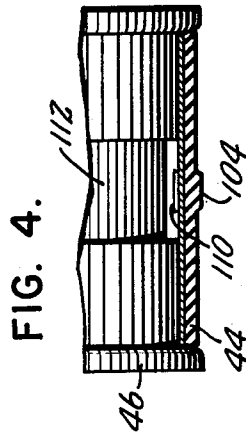
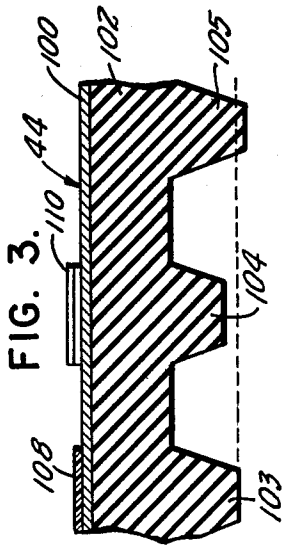
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PRINTING MACHINE

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7 Claims (Cl. 101—228)

This invention relates to an improved machine for printing accurately graduated tape measures, and more particularly to such a machine for printing long, flexible steel tape measures which are very accurately calibrated.

An object of this invention is to provide a machine for printing tape measures of improved quality at lower cost than has previously been possible.

Another object is to provide such a machine which is relatively simple in construction and operation and which can be built at reasonable cost.

These and other objects will in part be understood from and in part pointed out in the description given herein-after.

In printing long steel tape measures, for example fifty feet or more long, the physical length of the tape creates many difficulties not encountered with shorter tape measures. With the latter it is easily possible to print the entire tape at one stroke in a flat-bed press, for example, and so obtain a high degree of accuracy in printing the inch and foot marks or graduations along the tape. However, a printing machine of sufficient size to simultaneously print the entire length of a fifty foot tape is necessarily very large and correspondingly expensive. Additionally, the operation of such a machine is necessarily awkward and intermittent and hence its production rate is limited.

It would be very desirable from the standpoint of economy or cost in manufacturing tape measures to be able to print the distance graduations on a blank metal ribbon or strip continuously as the ribbon is unreeled from a large supply roll. However, with long tape measures, previous arrangements have not been able to print the graduations with sufficient accuracy. One reason for this is that a very small error in printing each foot mark is repeated many times along the length of the tape and the cumulative error becomes excessive. The present invention provides an improved machine which is able to print very long steel tapes on a continuous basis and with an extremely high degree of accuracy. Moreover both the graduations and the numerals printed on the tape are clear, highly legible and uniform, hence quite easy to read. The machine is able to operate at relatively high speed and there is minimum wear on the master printing scales in the machine. Accordingly there is little or no deterioration in the quality of printing throughout a very long period of operation.

In accordance with the present invention, in one specific embodiment thereof, there is provided a machine for printing very long steel tapes graduated in fractional inch and foot intervals and with the foot numerals printed in different color if desired. The master scale for printing the inch and foot graduations is mounted in a special way on a cylindrical drum and rolls in contact with the tape. This scale and the other parts of the machine are so accurately proportioned that at the end of a fifty foot tape, for example, the cumulative or total error in printed distance can be held to less than one-hundredth of an inch. To aid in keeping this error so minute, the tension of the tape as it is being printed is carefully controlled. By increasing the tension the distance graduations will be closer together when the tape is released, and by decreasing the tension these marks will be farther apart. Thus, the effects of difference in room temperature are easily compensated for during actual printing of the tape.

2

Independently of the printing of the inch and foot graduations on the tape, the foot numbers along the tape, for example, one to fifty, are printed from a separate master scale which is mounted as an endless belt and which is driven in unison with the inch and foot scale drum. These numbers can if desired be printed in a different color from that of the graduations. Also by changing the length of the belt scale tape measures of a different length can be manufactured using the same drum scale. The relative printing positions by these scales of the graduations and of the numerals along the tape are controlled during operation of the machine so that they coincide to within at least a tenth of an inch.

A better understanding of the invention together with a fuller appreciation of its many advantages will best be gained from a study of the following description given in connection with the accompanying drawings wherein:

FIGURE 1 is a perspective view of a high precision tape printing machine embodying features of the invention;

FIGURE 2 is an opposite side view of a portion of the machine;

FIGURE 3 is a greatly enlarged side-section view of a portion of a master printing strip showing several of the raised print characters;

FIGURE 4 is a somewhat smaller view than in FIGURE 3 showing in cross-section the mounting of such a strip on a drive pulley; and

FIGURE 5 shows the adjustable mechanical connection between the printing drum and the drive mechanism of the belt printing scale to control the relative positions of the graduation marks and the foot numbers.

The machine 10 seen in FIGURE 1 has an open frame 11 and is supplied from the front left with a blank metal ribbon 12 which is unreeled from a large supply roll 14 and passes in the direction of arrow 16 over pulleys 18, 19 and 20 into the machine. As it passes through the machine, the blank metal strip is printed with inch and foot graduations and with inch and foot numerals to make a finished tape measure which then passes out of the front of the machine down, around a pulley 22 and up, around a pulley 24 to a drying zone (not shown). As the printed tape passes beyond the pulley 24 it is compared against a standard tape measure 26 to check the accuracy of the just printed tape.

To maintain a high accuracy for the tape being printed, supply roll 14, which is rotatably mounted on stationary frame 30, is adjustably braked by an electromagnetic clutch 32 controlled from a rheostat 34. By varying this rheostat, the tension along blank ribbon 12 as it passes into the machine is precisely adjusted thereby controlling to a fine degree the resulting distances between the graduations printed on the tape.

As ribbon 12 enters machine 10 it passes over an idler pulley 36 and around a large power-driven cylindrical drum 38 rotatably mounted on frame 11 through a shaft 39. The metal ribbon is pulled tightly against and nearly 360° around the surface of this drum and is driven by friction substantially without slipping beneath and against an overhead printing drum 40 mounted on a cantilever shaft 41. The latter drum rotates in synchronism with drum 38 and carries around its circumference a rubber-faced master printing strip 42 which will be described in detail later. The length of this strip equals, for example, exactly four feet so that in one revolution of drum 40, strip 42 will roll in contact with the blank metal ribbon and print four one-foot lengths or series of graduations along it. The next revolution of drum 40 will print the next four feet of graduations, and so on until the length of the tape has been completed.

Simultaneously with the printing of the inch and foot graduations by strip 42, there is printed on the metal rib-

bon each of the foot numerals. The latter are printed by an endless belt strip 44 mounted vertically just behind drum 38. The lower end of belt strip 44 is stretched around and supported by a drive pulley 46 and the upper end (see FIGURE 2) is stretched around an idler pulley 48. Belt 44 is driven so that its forward run moves upward in unison with the rotation of drum 38 and the tape being printed. This strip is similar in structure to strip 42 but of course is much longer in order to equal the entire length of each tape measure being printed. The forward run of strip 44 is resiliently urged against drum 38 and ribbon 12 for printing by an adjustable pinch roller 50. As will appear, the phasing between the printing applied by band strip 44 and that applied by drum strip 42 is adjustable so that the foot numbers and the foot graduations coincide precisely.

As seen best in FIGURE 2, drum 38 is driven through shaft 39 by means of a sprocket 52 engaged by a chain 54 extending down to a drive motor and gear box, generally indicated at 56. Upper drum 40 is driven in synchronism from drum 38 by a large spur gear 58 fixed to shaft 39, through an adjustable pair of idler gears 60 and another spur gear 62 fast on shaft 41 and identical to gear 58. Drums 38 and 40 and pulley 46 are of the same diameter.

By setting the vertical height of shaft 41 above the rim of drum 38, the effective diameter of printing drum 40 and hence its circumference and the actual distance between the graduations printed on the tape by strip 42 is set. Once drum 40 has been so adjusted relative to drum 38, idler gears 60 are set so as to closely engage spur gears 58 and 62.

The endless band printing strip 44 is likewise driven in exact synchronism with drum 38 through its lower drive pulley which is mounted on a shaft 64 carrying a spur gear 66 also like gear 58. These two gears are engaged and driven together by a pair of idler gears 68.

Spur gear 66 is fast on shaft 64 but as seen in FIGURE 5, the hub 70 of pulley 46 is adjustably mounted thereon by a coupling arrangement generally indicated at 72. Hub 70 has projecting outward from it a pin 74 which rides in a slot 76 of an axially slidable plate 78. By manually controlling the back and forth position of this plate, the angular position of hub 70 and pulley 46 on shaft 64 is determined. This in turn determines the positions of the numerals printed on the tape by belt strip 44 relative to the graduations printed by drum strip 42.

Slotted plate 78 is carried on a rotatable collar 80 which is splined to shaft 64 and which is positively positioned along the shaft by a yoke 82 having two opposed rollers 84 engaged in a groove 86 at the right end of the collar. The yoke does not rotate and is adjustable in position to the right or to the left by means of a knob and screw 88 cooperating with a stationary threaded support 90.

An enlarged short lengthwise segment of belt strip 44 is shown in FIGURE 3. It comprises a thin metal backing strip 100 to which is vulcanized a thicker rubber printing strip 102 having raised portions, three of which are indicated at 103, 104 and 105, for printing graduations on the tape. The face of rubber strip 102 is made by moulding against a plate having negative engravings in it corresponding to printing portions 103, etc. Having been made in this fashion, the sides of these portions slope outward toward the rear face of the strip. Because of minor variations in the depths of the engravings, the forward or printing faces of these portions do not lie in exactly the same plane. Thus, for example, the printing face of portion 103 is level with a plane represented by the dotted line while portion 104 lies below the plane and portion 105 above. To compensate for these small variations in height the rear side of strip 100 is built up where required by short lengths 108, 110 of cellophane tape, for example, each of appropriate thickness.

As seen in FIGURE 4, belt 44 is mounted on pulley 46

(and on pulley 48) so that the center part of the strip where backed by the cellophane tape is not in contact with the pulley. The clearance space for this is provided by a shallow concentric groove 112 in the center of the drum face or rim. Thus, the backing tapes 108, 110 do not interfere with the driving of belt strip 44 and do not distort its effective length. However, when these tapes 108, 110 pass beneath pinch roller 50, they provide that each raised printing portion 103, etc., is urged against tape 12 with the same pressure.

Band strip 42 is essentially the same in structure as strip 44 though much shorter. Strip 44 has a width of 2½ inches for good traction and a thickness for strip 100 of .01 inch. The diameter of pulleys 46 and 48 (each 4 feet in circumference) is large enough so that this belt strip is not so severely flexed as to cause it to break.

During operation of the machine, ink is continuously applied to printing strips 42 and 44 by conventional ink applying mechanisms indicated respectively at 114 and 116.

The drawings herein were made from photographs of an actual machine which has been built and successfully tested. High quality, very accurate steel tapes ½ inch wide and 50 feet long were produced by this machine in continuous operation at the rate of 120 feet per minute. These tapes were equal or superior in quality to similar tapes made at the rate of 10 feet per minute on a previous machine not embodying the invention.

The above description of the invention is intended in illustration and not in limitation thereof. Various changes may occur to those skilled in the art and these may be made without departing from the spirit or scope of the invention as set forth.

I claim:

1. An improved machine for printing at high speed accurately calibrated, long flexible tape measures, said machine comprising: a frame, a large diameter drive drum rotatably mounted on said frame, a printing drum having a diameter equal to said drive drum and rotatably mounted on said frame with its rim adapted to roll tangent to the rim of said drive drum, a master printing scale in the form of a resilient strip having raised printing faces along it, said scale being resiliently mounted 360° around the rim of said printing drum and having a length which is an exact multiple of the integral distances to be printed on said tape measures, said scale printing faces being adapted to roll with even pressure against a blank tape pinched between themselves and the rim of said drive drum, means to apply ink to said scale as it rotates, means including a gear on each drum and a pair of adjustable idler gears between said gear to drive said drums in unison without backlash between them, and means to feed a blank tape around said drive drum and against said printing scale.
2. The machine as in claim 1 wherein said means to feed a blank tape includes a reel holding a coiled length of said tape, and brake means for adjustably varying the tension along said tape as it passes around said drive drum.
3. The machine as in claim 1 wherein said scale comprises a thin metal backing strip to which is affixed a rubber-like body having along its center part raised print characters, the width of said strip and body being substantially greater than the width of said characters, the rim of said printing drum having a central groove to permit said strip to flex inward against the pressure of said drive drum and tape strip, the length of said scale being of the order of several feet whereby the curvature of said scale when mounted on said printing drum is not excessive.
4. A compact and efficient machine for continuously printing long, flexible tape measures and the like which must be accurately graduated, said machine comprising a frame, a drive drum rotatably mounted on said frame, a printing drum rotatably mounted on said frame with its rim tangent to the rim of said drive drum, a first printing

5

scale mounted around the rim of said printing drum and having a length equal to a multiple of the unit distances to be printed on said tape, a second printing scale having a length equal to the full length of said tape, pulley and drum means for supporting and driving said second scale and for resiliently urging it into tangential contact with said drive drum, gear means for driving said drums and said pulley means in unison without backlash, said gear means including an adjustable interconnection for varying the relative longitudinal positions of said printing scales.

5 The machine in claim 4 wherein said pulley and drum means includes two spaced apart pulleys for supporting said second scale as an endless belt, and a drum for resiliently urging said second scale against said drive drum; and wherein said gear means includes a first large spur gear fixed to said drive drum, a second similar gear fixed to one of said pulleys, a first pair of adjustable idler gears meshed between said first and second spur gears, and a second pair of idler gears meshed between said first and third spur gears.

6. A compact and efficient machine for continuously printing long, flexible tape measures and the like which must be accurately graduated, said machine comprising a frame, tape drive and support means mounted on said frame, a printing unit mounted on said frame and having a peripheral portion co-extensive with the peripheral portion of said tape drive and support means and mounted to move therewith, a first printing scale mounted on the peripheral portion of said printing unit so as to contact a tape moving through the co-extensive zone of said peripheral portions, said first printing scale having a length equal to a multiple of the unit distances to be printed on said tape, a second printing scale having a length equal to the full scale of the tape, supporting and driving means for said second printing scale including means resilient-

6

ly urging the scale into contact with the tape as it passes along said tape drive and support means, synchronous drive means for driving said tape and said printing scales in unison including adjusting means for varying the relative longitudinal positions of said printing scales, and means to control the tension on the tape as it passes the printing zone.

7. A compact and efficient machine for continuously printing long, flexible tape measures and the like which must be accurately graduated, said machine comprising a frame, tape drive and support means mounted on said frame, a printing unit mounted on said frame and having a peripheral portion co-extensive with the peripheral portion of said tape drive and support means and mounted to move therewith, a first printing scale mounted on the peripheral portion of said printing unit so as to contact a tape moving through the co-extensive zone of said peripheral portions, said first printing scale having a length equal to a multiple of the unit distances to be printed on said tape, a second printing scale having a length equal to the full length of the tape, supporting and driving means for said second printing scale including means resiliently urging the scale into contact with the tape as it passes along said tape drive and support means, and synchronous drive means for driving said tape and said printing scales in unison including adjusting means for varying the relative longitudinal positions of said printing scales.

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