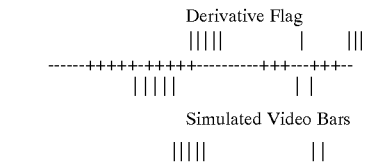
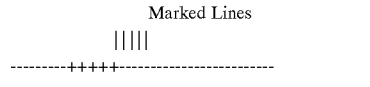
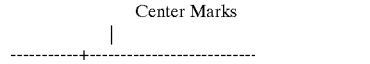
APPENDIX-continued



8. Look for at least 3 consecutive marked lines



9. Look for the center of each bar



10. Determine bit code from bar centers
11. Decode bit sequence and determine position in the chain code
    a) the chain code's bit sequence is saved in memory in 2^(N−4) words (e.g., a 14 bit code requires 2^(14−4) = 1024 words)
    b) N-bit sequences are extracted from the words
    c) each sequence is compared to the bit code to find a match
    d) the position is the word number, times the bits in the word (i.e., 16), plus the first bit position within the word, times the bit spacing (for the lab prototype, 0.025 inches).
    e) after the initial match, only the words in the vicinity of the previous match need be checked.
12. There are a minimum of 4 marks in each 14 bits of the chain code. The positions of the mark centers (in video lines) are related through a linear reduction with the position of the bit centers (in cylinder rod coordinates). The cylinder rod position relative to a central video position is computed from the line yielding a higher accuracy, but relative, position. The linear reductions from sequential readings are compared to generate a cylinder rod velocity. (Note: this action was only accomplished off-line with the lab prototype)

What is claimed is:

1. A device for sensing the position of a movable member which moves along an axis relative to a stationary member, comprising:

a scale including a nonrepeating code on the movable member aligned substantially along the axis;

a two-dimensional detector fixed to the stationary member and positioned to sense a portion of the scale within a view of the detector, said detector generating a plurality of signals, each signal indicative of the particular viewed portion of the scale sensed by the detector; and

a controller determining the position of the movable member relative to the stationary member as a function of the signals.

2. The device of claim **1** wherein the code comprises consecutive bits, where each bit is either a mark or a space, where N consecutive bits form a unique value as compared to any other N consecutive bits of the code.

3. The device of claim **2** wherein each mark has a length oriented substantially perpendicular to the axis and wherein the detector comprises an array forming L rows of elements and K columns of elements where L and K are integers and K is much greater than N, wherein each column of elements aligns substantially along the length of the marks, wherein the detector simultaneously views at least N consecutive bits of the code, and wherein each successive row or each successive column is read to generate the plurality of signals.

4. The device of claim **1** wherein the scale comprises an N-bit code where N is a sequential number of bits that form a unique value and where each bit is a mark or a space, each mark having a length oriented substantially perpendicular to the axis, and wherein the detector comprises an array forming L rows of elements aligned substantially along the length of each mark and forming K columns of elements aligned substantially along the axis of motion, the elements in each column read successively and adjacent columns being read successively to generate a plurality of signals.

5. The device of claim **4** wherein the portion of the scale being detected equals N+A bits, where A is greater than or equal to one, and wherein the portion of the scale being processed by the controller equals N bits within in the N+A bits being detected.

6. The device of claim **5** wherein two different sets of N bits within the N+A bits are processed by the controller.

7. The device of claim **4** wherein the code is a group of two repeating codes, where each repeating code has a different number of bits, where the number of bits do not have a common denominator, where when aligned with each other along the axis of motion the combination of N bits from each repeating code does not repeat for the length of the scale.

8. The device of claim **4** wherein the repeating codes are chain codes.

9. The device of claim **1** wherein the scale comprises evenly spaced bits of marks or spaces on the movable member and where the mark width is less than the bit spacing.

10. The device of claim **1** wherein the scale comprises evenly spaced marks, and wherein the length of the mark defines its bit value.

11. The device of claim **1** wherein the scale comprises unevenly spaced bits of marks or spaces on the movable member, and wherein the width of the mark or the width of the space defines the bit value.

12. The device of claim **1** wherein the scale comprises a code having N bits where each bit is a mark or a space, each mark having a length oriented substantially perpendicular to the axis, and wherein the detector comprises an array forming L rows of elements aligned substantially along the length of each mark and forming K columns of elements aligned substantially along a width of each mark, the elements in each row being read successively and adjacent rows being read successively to generate a plurality of signals.

13. The device of claim **12** wherein the portion of the scale being detected equals N+A bits, where A is greater than or equal to one, and wherein the portion of the scale being processed by the controller equals N bits within in the N+A bits being detected.

14. The device of claim **13** wherein two different sets of N marks within the N+A marks are processed by the controller.

15. The device of claim **1** wherein the scale comprises a chain code of bits represented by marks and spaces and having gaps therebetween, each mark having a width which is less than the spacing between marks and spaces.

16. The device of claim **1** wherein the detector comprises a housing supporting a substantially flat detector array for reading the scale, an optical conduit positioned between the array and the scale for transmitting an image of the scale onto the array, and an illumination source positioned to illuminate the scale.

17. The device of claim **1** wherein the detector comprises a housing supporting a substantially flat detector array for