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APPARATUS FOR MEASURING AREA

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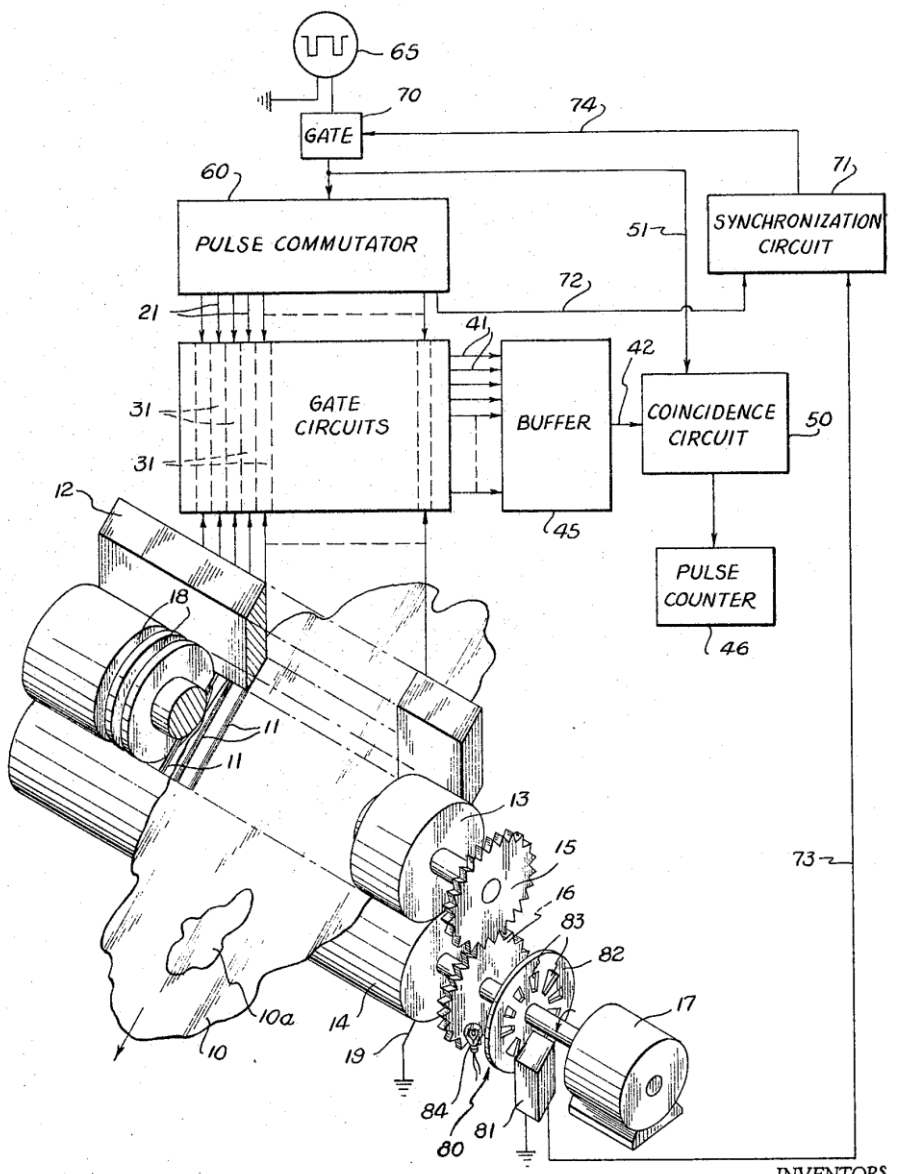

Fig. 1

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APPARATUS FOR MEASURING AREA

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1 Claim. (Cl. 33—123)

This invention relates to apparatus for measuring area, and more particularly to apparatus for measuring the areas of irregularly-shaped pieces of sheet material, such as pieces or cut-out portions of maps, graphs, aerial photographs and the like.

To measure the area of an irregularly-shaped piece of sheet material, it has heretofore been proposed that a two-dimensional array of sensing fingers, each capable of detecting the presence or absence of the sheet material, be provided and arranged to overlay the piece. By sampling the sensing fingers in sequence and registering a count for each sensing finger detecting the presence of the sheet material, the area of the piece of sheet material could be calculated in terms of the unit of area represented by each sensing finger. It has further been recognized in the art that the preferred manner of sensing the presence or absence of thin, paper-like sheet material is by electrical means. To this end, devices have been described which employ electrical probes or brushes for sensing fingers. In the utilization of these devices, the piece of thin sheet material is rendered conductive by depositing a metallic film thereon, and a common or return connection is made to the metallic film. The metallized piece is placed under the array of brushes, and a source of electric current is switched or commutated to the brushes in sequence. For each brush contacting the metallic film, a pulse of current is obtained at the return conductor. A counter is provided to register the number of pulses appearing at the return conductor, thereby providing a measure of the area of the metallized piece.

Since the requirement of providing a metallic film or layer on paper-like pieces of sheet material is time consuming and expensive, it would be highly desirable to provide an apparatus capable of electrically detecting nonconductive, i.e., insulative sheet material. Such an apparatus would be especially useful in determining or computing the areas of pieces of paper, photographic film, and the like.

An apparatus constructed in accordance with the principles of the present invention is capable of performing the desired sensing of insulative sheet material. Briefly, in the present invention the area of a piece of insulative sheet material is computed by employing the well-known calculus technique of dividing an area into parallel strips of unit width, whereby the area may be obtained as the product of the unit width and the sum of the lengths of the strips. This technique is implemented in a preferred embodiment of the invention by providing means for feeding the insulative piece beneath a row of reading brushes which normally contact a grounded roller. As the piece moves beneath the brushes, it isolates a number of brushes from ground, the number isolated at any time being proportional to the transverse dimension of the insulative piece at that time. For each brush, there is provided an associated pulse line which receives a pulse every time the insulative piece is advanced a unit distance. Each brush is connected so as to gate the pulse on its associated pulse line to a pulse counter in the event that the brush is isolated from ground. In this manner, every time the insulative piece is advanced a unit distance beneath the reading brushes, the brushes isolated from ground by the piece gate a number of pulses corresponding to the width of the piece beneath

the brushes to the counter. The total count, after the paper has completely passed under the reading brushes, accordingly is a measure of the area of the piece.

In measuring the areas of certain pieces of insulative sheet material such as maps, aerial photographs, and the like, it often is desirable to exclude small enclosed portions corresponding to bodies of water and the like. In the present invention, these enclosed areas may be omitted from the measurement of the area of the piece by simply cutting out the undesired portion, whereby the undesired portion, in passing under the reading brushes, does not isolate any brushes from ground and therefore does not gate any pulses to the counter. It is further possible to omit undesired enclosed portions by painting the portions with electrically-conductive paint, provided the pulse lines associated with the reading brushes are derived from a pulse switching network of the type comprising a plurality of logical AND circuits. In such a network, the connection of two or more of the output pulse lines together, as by means of the spot of conductive paint, prevents pulses from appearing on any of the interconnected pulse lines. Thus, the spot of conductive paint in passing under the reading brushes prevents the associated pulse lines from sending pulses to the counter.

Accordingly, it is an object of this invention to provide an apparatus capable of rapidly and precisely measuring the areas of pieces of sheet material such as paper and the like.

It is another object of this invention to provide an apparatus which measures the areas of pieces of thin sheet material by high speed pulse distributing, gating, and counting techniques.

Another object is to provide an apparatus for measuring the areas of pieces of sheet material wherein undesired portions of the pieces may easily and readily be excluded from the measurements.

Still another object is to provide a pulse-type area measuring apparatus in which the pulses are checked before being counted.

Yet another object is to provide a pulse-type area measuring apparatus in which the pulse distributor and piece drive are maintained in synchronism.

These and other objects, advantages and features of the present invention will become apparent as the following description is read in conjunction with the accompanying drawings, wherein:

FIG. 1 shows a preferred embodiment of the present invention, the mechanical elements thereof being shown in perspective view and the electrical elements in block diagram form;

FIG. 2 is a circuit diagram illustrating a representative portion of the commutator block and the gate circuit blocks of FIG. 1;

FIG. 3 is a block diagram of the coincidence circuit of FIG. 1, and

FIG. 4 is a block diagram of the synchronization circuit of FIG. 1.

In the preferred embodiment of the present invention illustrated in FIG. 1, the reference numeral **10** designates a piece of thin, electrically-insulative sheet material such as paper, cardboard, resinous film or the like, the area of which is to be measured. The outline of the piece **10** may be regular (e.g., rectangular), but generally will be irregular, having been cut by shears or knife from a map, graph, aerial photograph or the like. In accordance with the present invention this piece **10** is fed beneath a row of uniformly-spaced electrical reading brushes **11** carried by any suitable brush block **12**. The preferred mechanism for feeding the piece **10** includes a pair of rollers **13**, **14** which are geared together by gears **15**, **16** and driven by a suitable motor **17**. The top roller **13** is constructed of insulative material and is