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(71) Applicant: **ESRAC COMPUTER CORPORATION**
**131 Spring Street 6th Floor East**
**New York New York 10012(US)**

(72) Inventor: **Sinn, Robert S.**
**248 West 88th Street Penthouse B**
**New York, New York 10024(US)**

(74) Representative: **Wasmeier, Alfons, Dipl.-Ing. et al**
**Postfach 382 Greflingerstrasse 7**
**D-8400 Regensburg(DE)**

## (54) Electronic speed rating calculator and method.

(57) Apparatus and method are set forth for calculating a comparative speed rating for an entrant in a race such as a horserace so that the entrant's performance can be compared with the performance of other entrants. The speed rating is determined in accordance with a formula which is based on a relationship between speed and distance over a particular distance for a particular class of entrant and where the speed rating for an entrant other than the winner is determined over the actual distance covered by the non-winning entrant in the same time as the winner. The specific equations to determine the speed rating are as follows:
9 furlongs or less:

$$SR = \frac{\dfrac{(f \times 60 - L)}{(t)} + 0{,}077 \times f - 4{,}962}{0{,}008}$$

Above 9 furlongs:

$$SR = \frac{\dfrac{(f \times 60 - L)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

Where f is the length of the race in furlongs
Where L is the number of lengths horse was behind the winner
Where t is the time of the winner in seconds.

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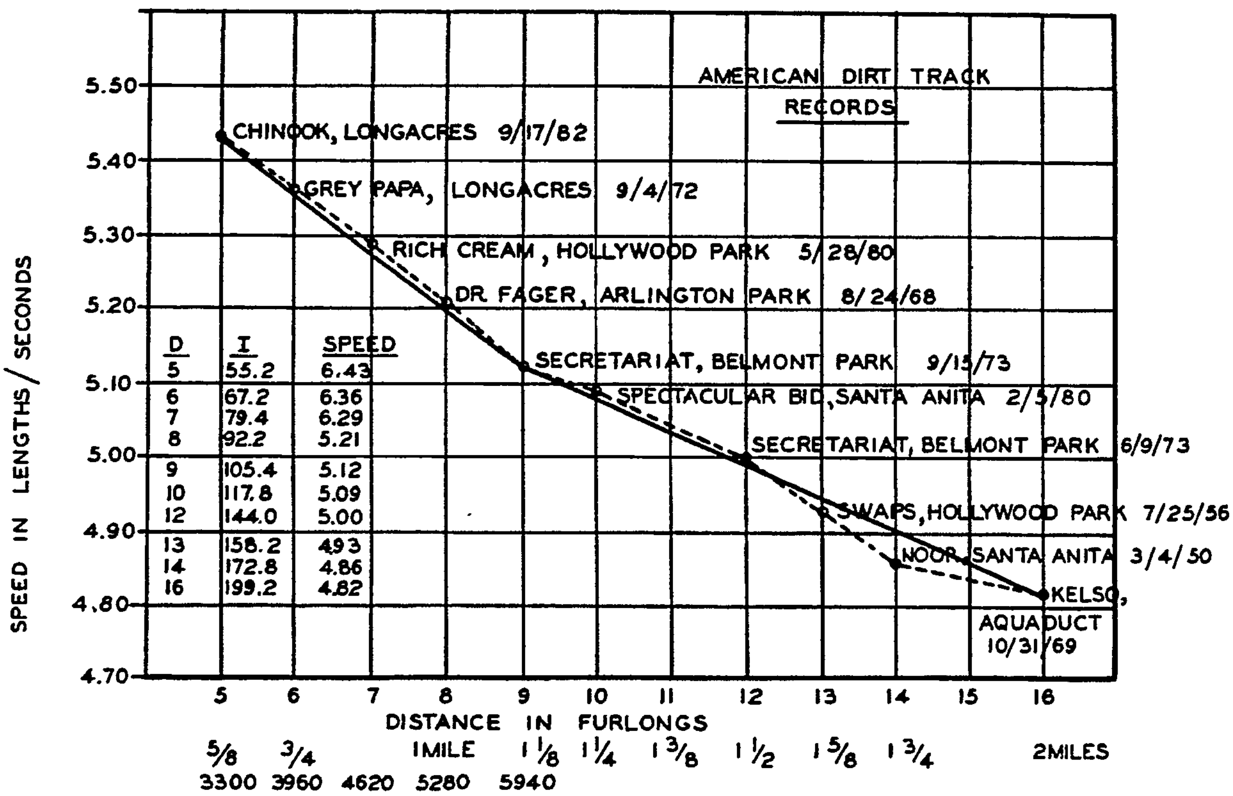
FIG. 1




| D | I | SPEED |
|---|---|---|
| 5 | 55.2 | 6.43 |
| 6 | 67.2 | 6.36 |
| 7 | 79.4 | 6.29 |
| 8 | 92.2 | 5.21 |
| 9 | 105.4 | 5.12 |
| 10 | 117.8 | 5.09 |
| 12 | 144.0 | 5.00 |
| 13 | 158.2 | 4.93 |
| 14 | 172.8 | 4.86 |
| 16 | 199.2 | 4.82 |

# ELECTRONIC SPEED RATING CALCULATOR AND METHOD

## BACKGROUND OF THE INVENTION

The present invention relates to methods and systems for calculating speed rating for participants in a speed contest or race. More particuarly, the present invention relates to methods, systems and formula for determining a speed value or speed rating for participants, such as race horses, in a speed contest, such as a horse race, for example.

There are many methods for calculating a speed rating for race horses. A speed rating of a race horse is a comparative rating of the speed of the particular horse compared with the optimum speed for the particular race, taking into account the distance, in furlongs, of the race.

An animal's ability to race is a function of this innate ability modified by his physical condition at the time of the race. That is, an animal in peak physical condition can run over a given distance at a certain average speed, taking into account that the particular animal is, at the time, running the distance at its ultimate capacity and no further amount of training can improve its performance. The innate ability to race for the individuals of any species has a bell shaped curve, the same as all other physical and performance characteristics, such as height or intelligence. The individuals of a species tend toward a norm, that is, the peak of the bell shaped curve, with exceptional individuals of the species out at the tails on either end of the bell.

For many years, horse racing enthusiasts have been seeking a method to evaluate the innate running capacity of horses, at various distances. This is difficult for several reasons:

a) Horses race at many different distances and there is great difficulty in relating the performance in one race at one distance to another performance in another race at another distance.

b) Although past performance of all horses in a race are published in a publication called the Daily Racing Form, only the time of the winner is given, other horses in the race are related to their position in the group at the finish line relative to the number of lengths the horse is behind the winner when the winner crosses the finish line. The distance of a length is 1/60th of a furlong. One furlong as a unit of distance is equal to 220 yards or one eighth of a standard mile. The rule of thumb is to add one fifth of a second to the time of the winning horse for each length the horse is behind the winner at the finish line. This rule of thumb is only accurate if the horses are running at the exact speed of one furlong per 12 seconds and is inaccurate for all other speeds.

c) The same horse will run at different speeds on different tracks. This difference is a function of the track structure, i.e., the length of the track and the track condiiton. There are both long term and short term variations. Long term variations are a function of the track structure, while short term variations are a function of weather, ground conditions, amount of scraping, etc.

The racing class of a horse is related to his position on the bell shaped performance curve. A horse of high class, a horse whose position on the curve is out on the high side of the bell, will beat a horse of average class, a horse whose position on the curve is at the peak of the bell at any typical racing distance. Higher class horses appear to have more ability and tend to perform better than lower class horses at all racing distances.

The problem is how to rate a horse's racing ability such that:

a) Horses of the same class average the same rating at all distances.

b) Horses of different class have different ratings on an ascendant scale with performance.

c) Horses taken indiviudally on the average have the same speed rating at all distances.

Some of the above problems have found solution in the teachings of U.S. Patent No. 4,133,031 in which the speed rating of a race horse is calculated by a method that employs a linear relationship between speed and distance for horses of the same class, parallel linear relationship between horses of different classes and a linear relationship between speed and distance for a particular horse, and where taking into consideration those linear relationships a specific equation is employed to determine the winner. The equation taught is as follows:

$$SR = \frac{\frac{(f60 - L)}{(t)} + 0{,}07f - 4{,}92}{0{,}008}$$

Where f is the length of the race in furlongs.
Where L is the number of lengths the horse was behind the winner when the winner crossed the finish line.
Where t is the time of the winning horse, in seconds.

It has been found that this equation is substantially accurate and effective for deriving the speed rating (SR) for race distances up to nine furlongs, a mile and 1/8. When this equation is employed to obtain or derive a speed rating for horses racing at distances in excess of nine furlongs, the speed rating obtained falls short of plotting a substantially straight line curve for races over 9 furlongs.

## SUMMARY OF THE INVENTION

The present invention provides another equation for solving the speed rating (SR) of a horse, which equation is more effective when applied Lo races having a distance of more than nine furlongs. The equation is:

$$SR = \frac{\frac{(f \times 60)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

Where f is the length of the race in furlongs.
Where t is the time of the winning horse in seconds.

This formula may be used to calculate the speed rating (SR) of the winning horse, and when used on a horse holding dirt track records, an essentially straight line curve is generated which declines linearly as a function of the length of the race.

For calculating the speed rating (SR) for horses in the same race, the equation is:

$$SR = \frac{\frac{(f \times 60 - L)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

Where f is the length of the race in furlongs.
Where L is the number of lengths the horse was behind the winning horse when the winning horse crossed the finish line, and
Where t is the time of the winning horse, in seconds.

It is therefore an object of the present invention to calculate a speed rating for a race horse using the equation:

$$SR = \frac{\frac{(f \times 60 - L)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

Accordingly, the method of the present invention includes the steps of classifying the entrant relative to other entrants in the same or similar sporting events. The speed rating of the entrant is calculated according to the mathematical formula shown above, which formula includes the pertinent factors for determining a speed rating for each entrant independent of varations such as track and classification of the entrant. Thus, by the method of the present invention, a speed rating is calculated which is general in its application in that the same speed rating applies for the entrant regardless of the distance of the race to be run.

The apparatus of the present invention includes means for data entry such as a keyboard similar to keyboards commonly used by 4-function arithmetic calculators, a random access memory for storing input data and other intermediate and output data, an arithmetic unit for calculating a speed rating given the input data, a display device for displaying selected data, and a read-only storage program control for controlling the sequence of steps to be ,executed in the calculation of a speed rating.

These and other objects, features, and advantages of the present invention, together with the operation of the invention, will be understood by reference to the following detailed description taken together with the following drawings.

## DETAILED DESCRIPTION OF THE INVENTION

For many years horse racing enthusiasts have been seeking a method to evaluate a horse's innate running capacity at various distances. This is difficult for several reasons:

1. Horses race at many different distances and there is great difficulty in relating performances at the different distances. For example, if you knew the racing ability of horse B at 1 1/2 miles and the racing ability of horse A at 1 mile, who would be the fastest at 1 1/4 miles?

2. The past performances of all horses in a race are published in the Daily Racing Form; however, only the time of the winner is given. The number of lengths that each other horse in a race was behind the winner at the finish is also given. The rule of thumb is to add one fifth of a second to the winning time for each length behind the winner. This rule of thumb is inaccurate.

3. The same horse will run at different speeds on different tracks. This difference is caused by the track structure and the track condition. There are long term variations (track structure) and short term variations (weather) and etc.

A horse's racing class is related to this position on the bell shaped performance curve. A horse of high class (out on the high side tail of the bell) at any typical racing distance. Higher class horses tend to perform better than lower class horses at all racing distances.

The problem is how to rate a horse's racing ability such that:

1. Horses of the same class average the same rating at all distances.

2. Horses of different classes have different ratings on an ascendant scale with performance.

3. Horses taken individually on the average have the same speed rating at all distances.

The present speed rating systems do not meet the criteria as stated above. In most systems such as the Daily Racing Form one point is subtracted from 100 for each fifth of a second the horse's performance was higher than the track record at that distance. This system does not meet the criteria stated above for the following reasons:

1. One fifth of a second at a distance is much less than one fifth of a second at a sprint.

2. The track records at different distances could have been set by horses of different classes. The track record is a function of the horse that set the record.

3. The rule of thumb of one fifth second equals one length is not accurate.

In all the present systems of speed ratings, the focus is on the time of the race. If the average winning times of horses of the same class are plotted as a function of the distance of the race, the resultant curve is nonlinear, however, if the average speed is plotted as a function of distance, the resultant curve is a straight line below 9 furlongs and a straight line at a different slope above nine furlongs. This relationship is shown in Fig. 1 for North American Records at distances from 6 furlongs to 16 furlongs. Research on the speed-distance characteristics of all classes of race horses from distance of 5 furlongs to 1 1/2 miles has confirmed that all classes of horses exhibit the same straight lines (linear) relationships: of average speed versus distance.

The basic discovery of the linear relationship of speed and distance for horses of the same class now allows for a system which fulfulls the original requirements of the speed rating system. The slope of the line relating North American Records was found to be about exactly the same as the slope of the line relating horses of all different classes of horses. This slope is approximately (0,07) length/second furlong below 9 furlongs and approximately (0,0465) length/second above nine furlongs.

Fig. 1 illustrates the generator of the speed rating system. The ordinate is the average speed over the distance. The abcissa is the distance in furlongs. The desire is to make a scale of 0-100 where the vast majority of all performances will fall within that scale. The rating of 100 is chosen as follows: an optimum speed at 9 furlongs is 5 lengths per second (this is approximately the North American Record - See Fig. 2) this is assigned a speed rating of 100, the minimum speed at 9 furlongs is assigned a speed rating of 0. The 100 speed rating line is then drawn for the ordinate 5 with a slope of (-0,0465). Each 0,08 length/sec. at

9 furlongs reduces the speed rating by 10 until a speed rating of 0 is achieved. Fig. 2 then illustrates the family of speed rating lines so generated.

Let f = Distance of race in furlongs

Let S = Average speed of runner in lengths/sec

Let Sr = Speed rating

Let Cr = The value where the r speed rating intercepts the vertical axis (speed in lengths/sec.) at zero distance (f = 0).

Let t = Race time of winner in seconds

The equation for the 100 speed rating line is:

$.^{S}100 = 5{,}48 - (0{,}0465)f$

The equation for the 90 speed rating is:

$.^{S}90 = 5{,}40 - (0{,}0465)f$

The equation for the 80 speed rating is:

$.^{S}80 = 5{,}32 - (0{,}0465)f$

$.^{S}0 = 4{,}68 - (0{,}0465)f$

The problem now is to generate the speed rating as a continuous function of the average speed of the runner at the distance.

Therefore

$,^{S} = Cr - (0{,}0465)f$

$,Cr = 4{,}68 + Sr(0{,}008)$

Substitute Cr in previous equation

Therefore

$,S = 4{,}68 + Sr\,(0{,}008) - (0{,}0465)f$

Solve for Sr

$$SR = \frac{S + (0{,}0465)f - 4{,}68}{0{,}008}$$

For winner

$,S = (60\ f/t)$

Therefore (1)

$$SR = \frac{\frac{60f}{(t)} + .(0465)\ f - 4{,}68}{0{,}008} \qquad (1)$$

Equation 1 then relates the speed rating as a function of time and distance over 9 furlongs.

This equation must be modified for non-winners because their winning time is not given in the Daily Racing Form. Many different methods of calculating the losing horse's average speed over the distance are possible. One method is:

Let L = lengths behind winner at the time winner crosses the finish.

Let $S_2$ = Average speed of the loser.

Therefore

$$S_2 = \frac{f(60) - L}{(t)} \qquad (2)$$

$$SR = \frac{\frac{(f60 - L)}{(t)} + .(0465)\ f - 4{,}68}{0{,}008}$$

Equation 2 is then used for both winners and losers with L = 0 for winners.

Extensive research has proved that this equation generates a consistent family of speed ratings satisfying the original requirements.

Once the equation for calculating speed rating has been determined which is general enough to cover all variables involved in a sporting event such as a horse race, the method for executing the calculations becomes apparent and is as follows:

1. Determine an optimum average speed based upon superior performance for the distance.
2. Determine the minimum average speed which experience has shown to have 0 value for the particular kind of sporting event in question.
3. Determine intermediate values between the optimum and the minimum for speeds at various distances for races.
4. Then so]ve using the formula

$$SR = \frac{\frac{(f60 - L)}{(t)} + .(0465)\ f - 4{,}68}{0{,}008}$$

The equation shown above may be executed by a special purpose digital computer or be a sequence of program steps executed on a general purpose digital computer.

Referring to Fig. 3, an electronic speed rating calulator 10 may be packaged as a hend-held calculator having function keys 12, 13 14 and 15 for identifying the data to be entered on data entry keys 16. A display 18 is included to provide visual display of input data and speed rating result.

The speed rating calculator includes data input means which could be keyboard 12-16. The data entry means is connected to arithmetic unit which executes arithmetic functions in the calculator and to random access memory for storage of entered data. Program control read-only storage controls the sequence of arithmetic and logic functions performed by the calculator. Control and timing logic interacts with all other inputs, data input means, arithmetic unit, random access memory, and display to control execution of the speed rating calculation.

Referring now to calculations, the operation of a calculator according to the present invention contains the following steps:

(a) Data entry of distance in furlongs, gap in lengths, and t in seconds.
(b) Multiplying f by 60.
(c) Adding L to -60f and storing the result.
(d) Dividing the result by t and storing the new result.
(e) Calculating 0,0465f.
(f) Adding 0,0465f to the result previously calculated.
(g). Adding a constant (4,68) to the calculation.
(h) Dividing by 0,008.
(i) Storing and displaying the result which is the speed rating.

The following is a listing of the program steps to execute the speed rating for a Hewlett Packard 71 B Calculator.

```
10 DISP "SRS 02/29/87" @ FIX 0
20 INPUT "DISTANCE = ";F @ INPUT "TIME = ";T @ INPUT "LENGTHS = ";L
30 A=60*F/T
40 IF F>9 THEN 60
50 B=0,077*F @ C=4,96 @ GOTO 70
60 B=0,0465*F @ C=4,686
70 S=(A+B-C)/ 0,008
80 DISP "SR("&STR$(F)&", "&STR$(T)&","&STR$(L)&")=";S @ END
```

The following is a listing of the program steps to execute the time of a horse for a Hewlett Packard 71 B Calculator.

```
10 DISP "SRT 02/29/87" @ FIX 2
20 INPUT "DISTANCE = ";F @ INPUT "SR = ";S
30 IF F>9 THEN 50
40 T=60*F/(0,008*S-0,077*F+4,96) @ GOTO 60
50 T=60*F/(0,008*S-0,0465*F+4,686)
60 DISP "T("&STR$(F)&","&STR$(S)&")=";T @ END
```

As can be seen from the method steps outlined above, when the program control read-only storage initiates the routine to calculate a speed rating, the first step is a data entry.

While the present invention has been described with reference to preferred embodiments thereof, it is understood by those skilled in the art that various changes in form and application of the electronic speed rating calculator and method may be made without departing form the spirit or scope of the invention.

## Claims

1. An automatic speed rating method for determining the speed rating of an entrant in a speed contest over a predetermined distance comprising, in combination:
determining the world class record for the speed of horses at particular distances
determining the length of the race in furlongs (f)
determining the number of length the entrant was behind the winner when the winner crossed the finish line (L)
determining the time of the winner (t)
inputting the above into the relationship

$$SR = \frac{\frac{(f \times 60 - L)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

for determining the speed rating of the entrant.

2. The automatic speed rating method according to claim 1 wherein the entrants are horses and the race is a horse race over substantially nine furlongs.

3. An automatic speed rating computer for determining the speed rating of an entrant in a speed contest over a predetermined distance with the length of the race (f), the number of lengths the entrant was behind the winner (L) when the winner crossed the finish line and the time of the winner (t), and including means for determining the speed rating of the entrant in accordance with the relationship

$$SR = \frac{\frac{(f \times 60 - L)}{(t)} + 0{,}0465 \times f - 4{,}686}{0{,}008}$$

4. The automatic speed rating computer according to claim 1 wherein the entrants are horses and the race is a horse race over substantially nine furlongs.

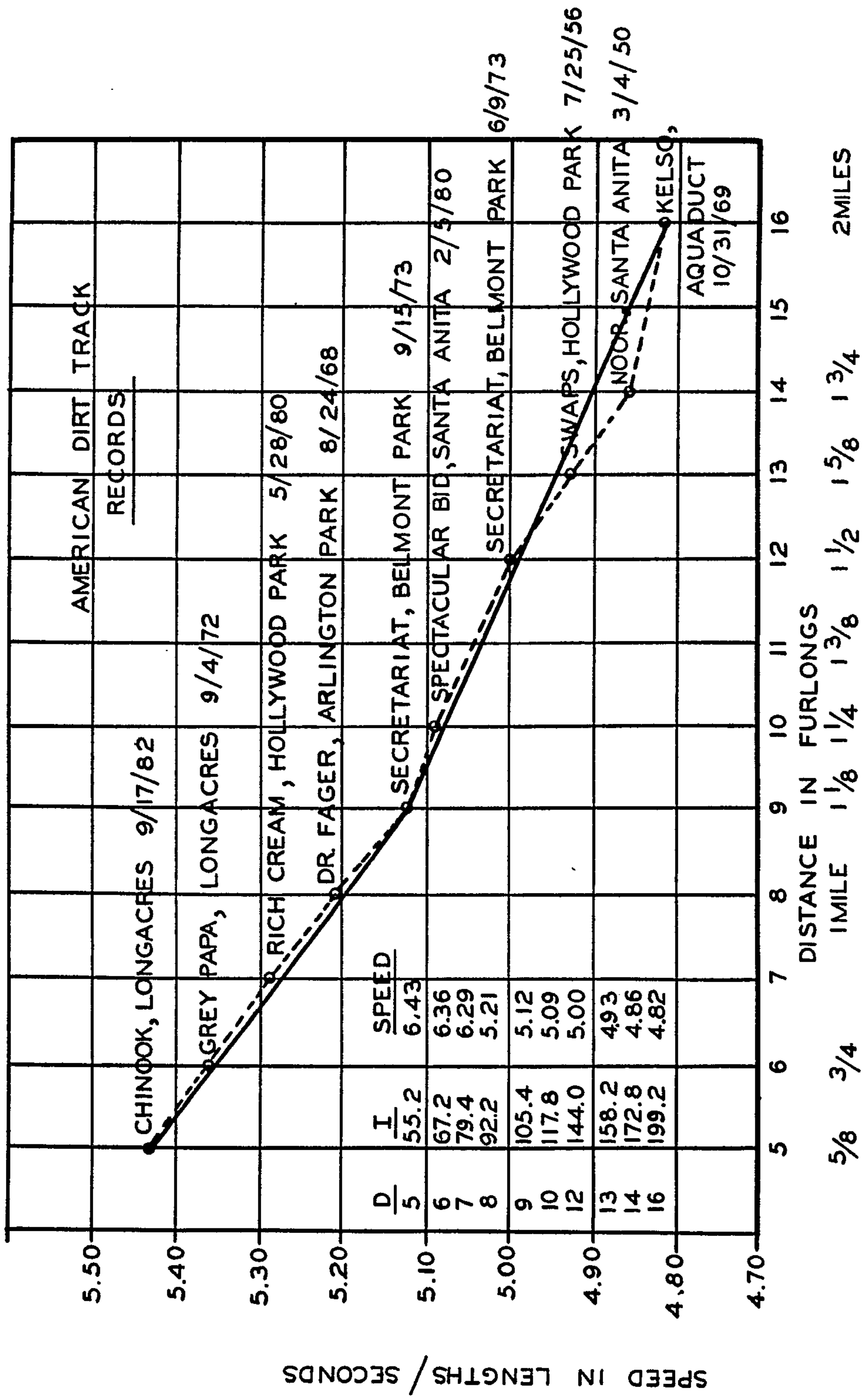

AMERICAN DIRT TRACK RECORDS
CHINOOK, LONGACRES 9/17/82
GREY PAPA, LONGACRES 9/4/72
RICH CREAM, HOLLYWOOD PARK 5/28/80
DR. FAGER, ARLINGTON PARK 8/24/68
SECRETARIAT, BELMONT PARK 9/15/73
SPECTACULAR BID, SANTA ANITA 2/3/80
SECRETARIAT, BELMONT PARK 6/9/73
SWAPS, HOLLYWOOD PARK 7/25/56
NOOR, SANTA ANITA 3/4/50
KELSO, AQUADUCT 10/31/69
D I SPEED
5 55.2 6.43
6 67.2 6.36
7 79.4 6.29
8 92.2 5.21
9 105.4 5.12
10 117.8 5.09
12 144.0 5.00
13 158.2 4.93
14 172.8 4.86
16 199.2 4.82
5.50 5.40 5.30 5.20 5.10 5.00 4.90 4.80 4.70
5 6 7 8 9 10 11 12 13 14 15 16
DISTANCE IN FURLONGS
5/8 3/4 1MILE 1 1/8 1 1/4 1 3/8 1 1/2 1 5/8 1 3/4 2MILES
3300 3960 4620 5280 5940
SPEED IN LENGTHS / SECONDS

FIG. 1

FIG. 2
SPEED RATING LINES

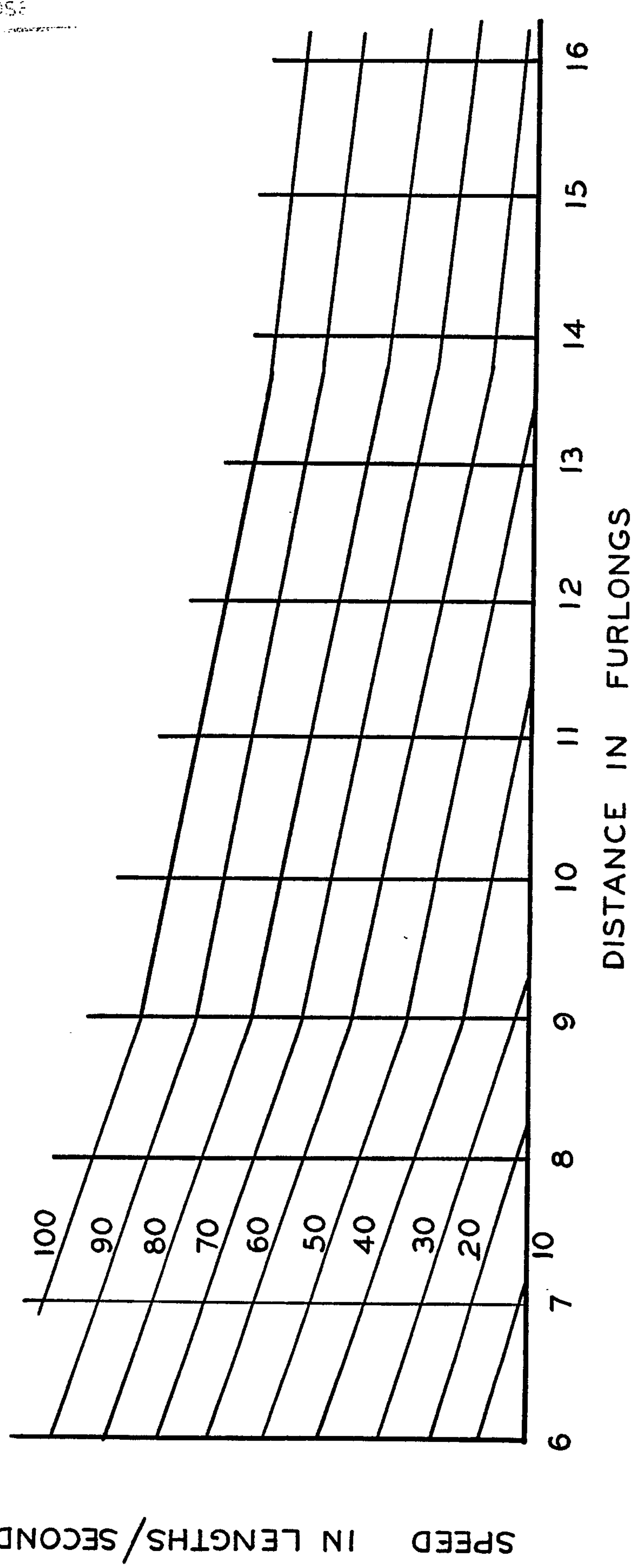
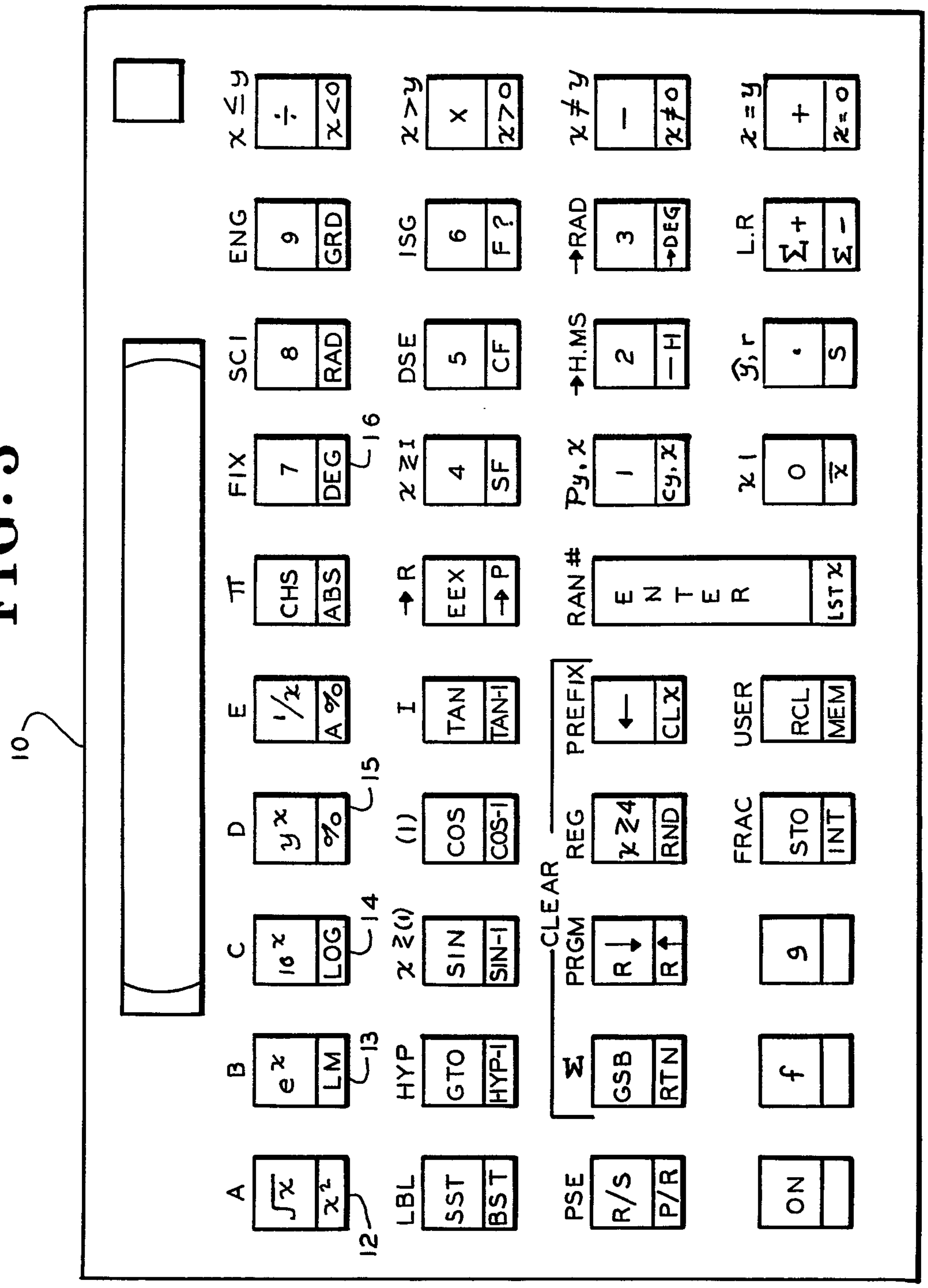


FIG. 3



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# EUROPEAN SEARCH REPORT

Application Number

EP 89 10 7925

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| D,X | US-A-4 133 031 (ESRAC)<br>* Column 2, line 40 - column 3, line 53 *<br>--- | 1,3 | G 06 F 15/28 |
| A | US-A-4 382 280 (MATTEL)<br>* Column 1, lines 27-51 *<br>--- | 1,3 | |
| A | GB-A-2 093 237 (DUTCHFORD)<br>* Page 1, line 4 - line 84; figures 1-4 *<br>--- | 1,3 | |
| A | FR-A-2 515 389 (DUBARRY)<br>* Page , line 19 - page 2, line 23; page 2, line 39 - page 3, line 14; page 4, line 37 - page 6, line 36; figure 2 *<br>----- | 1,3 | |
| | | | TECHNICAL FIELDS SEARCHED (Int. Cl.5) |
| | | | G 06 F 15/28 |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 05-12-1989 | CHUGG D.J. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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