HAT Altimeter

No 3797308

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Aircraft Landing Altimeter
19 Mar 1974

Noted and approved. 22 Mar 74

Whereas, THERE HAS BEEN PRESENTED TO THE

Commissioner of Patents

A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL INVENTION THE TITLE AND DESCRIPTION OF WHICH ARE CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PATENT OFFICE IN THE CLAIMANT (S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID CLAIMANT (S) IS (ARE) ADJUDGED TO BE ENTITLED TO A PATENT UNDER THE LAW.

NOW, THEREFORE, THESE Letters Patent ARE TO GRANT UNTO THE SAID CLAIMANT (S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID CLAIMANT (S) FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS RANT, SUBJECT TO THE PAYMENT OF ISSUE FEES AS PROVIDED BY LAW, THE HT TO EXCLUDE OTHERS FROM MAKING, USING OR SELLING THE SAID INVENTION OUGHOUT THE UNITED STATES.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this nineteenth day of March, in the year of our Lord one thousand nine hundred and seventy-four, and of the Independence of the United States of America the one hundred and ninety-eighth.

Attest:

Edward M. Fletcher, Jr.
Attesting Officer.

C. Marshall Dann
Commissioner of Patents.

FORM PO 377A
(10-65)

BUREAU OF ENGRAVING AND PRINTING

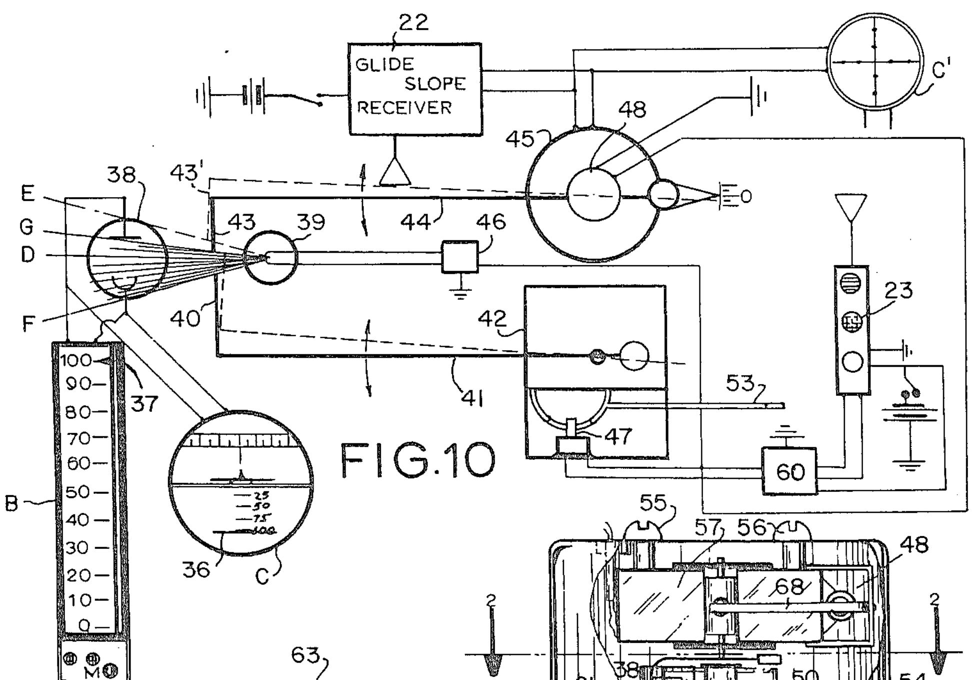

FIG.10

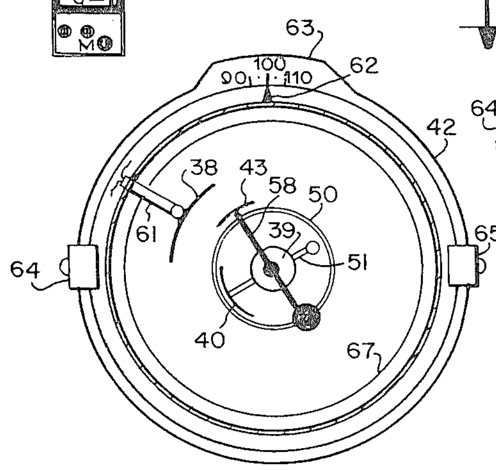

FIG.12

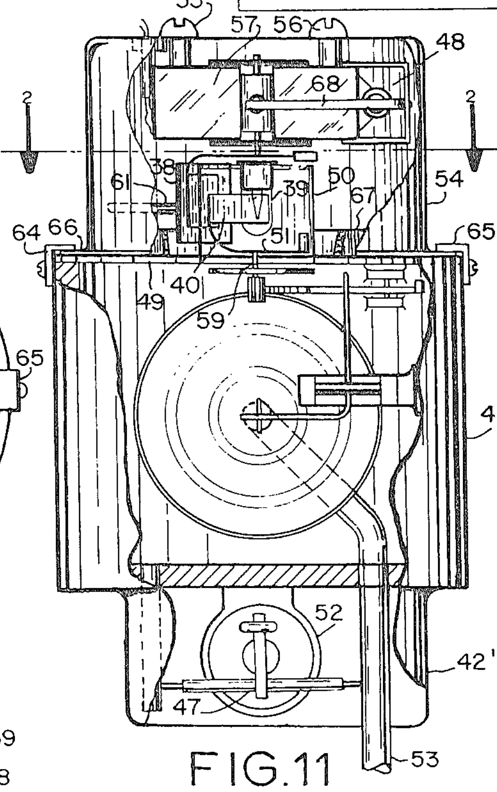

FIG.11

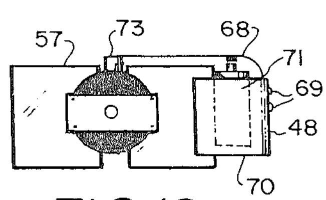

FIG.13

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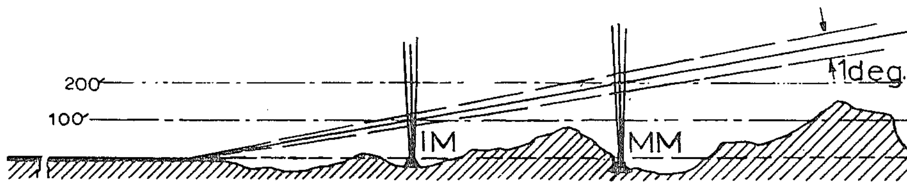

FIG.3

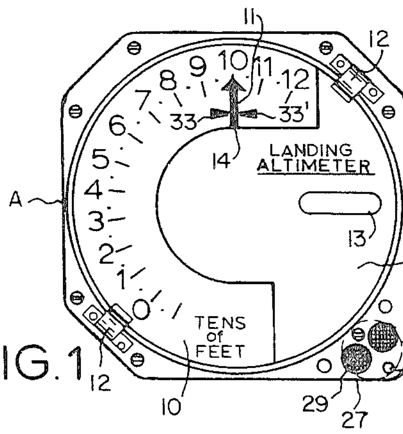

FIG.1

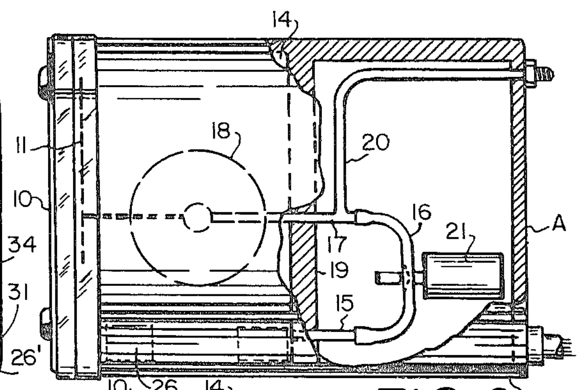

FIG.2

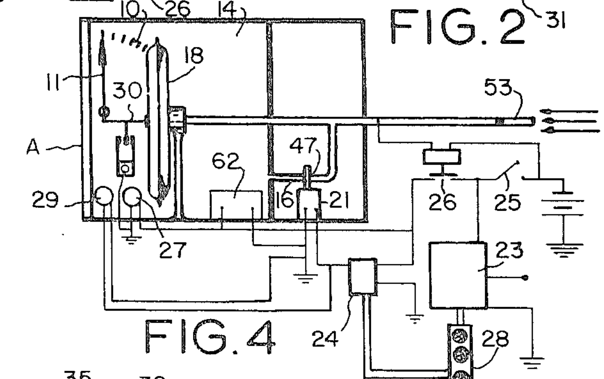

FIG.4

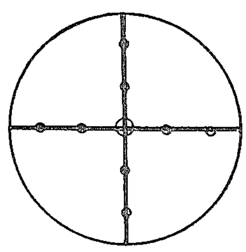

FIG.6

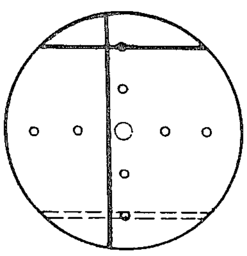

FIG.7

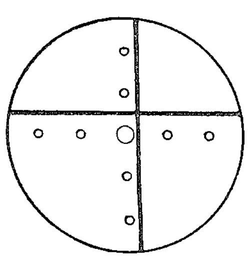

FIG.8

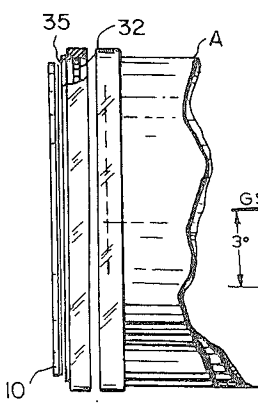

FIG.5

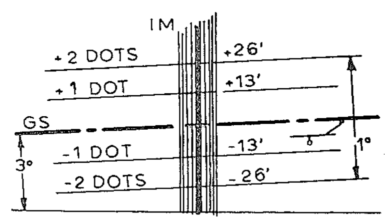

FIG.9

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4] AIRCRAFT LAND
6] Inventor: Carl J.
Tex. 78
2] Filed: Nov. 6,
1] Appl. No.: 303,828

2] U.S. Cl. ....
1] Int. Cl. ....
8] Field of Search.......

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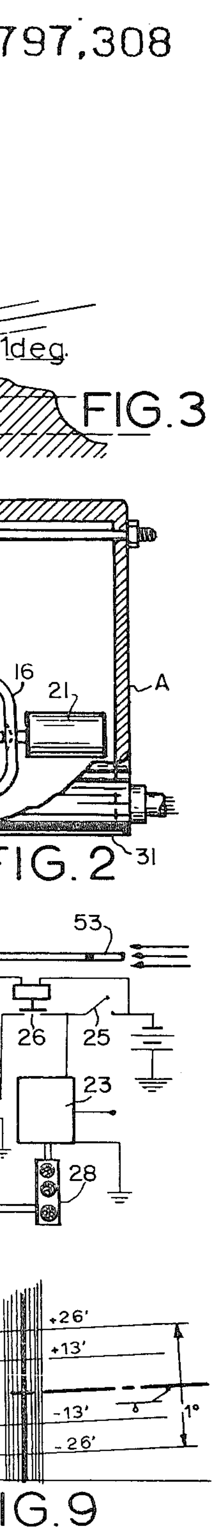

United States Patent [19]

Crane

[11] 3,797,308

[45] Mar. 19, 1974

[54] **AIRCRAFT LANDING ALTIMETER**

[76] Inventor: **Carl J. Crane**, Box 316, Helotes, Tex. 78023

[22] Filed: **Nov. 6, 1972**

[21] Appl. No.: **303,828**

[52] **U.S. Cl.** .... **73/178 T,** 73/386
[51] **Int. Cl.** **G01c 21/00,** G01l 7/12
[58] **Field of Search**.......... 73/386, 387, 179, 178 T, 73/178 H

[56] **References Cited**

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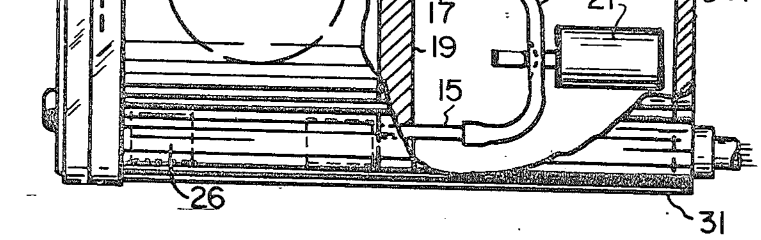
1,935,736	11/1933	Colvin et al.	73/179
2,347,134	4/1944	Sidwell	73/386
3,282,111	11/1966	Andresen, Jr.	73/386

Primary Examiner—Donald O. Woodiel
Attorney, Agent, or Firm—Krafft & Wells

[57] **ABSTRACT**

An aircraft landing altimeter is obtained for indicating height above touchdown of a landing aircraft after passing a known distance and known height from touchdown point. The indicator pointer responds to static atmospheric pressure difference between the touchdown point and that along the glide slope (ILS) at a selected marker beacon site.

3 Claims, 13 Drawing Figures



AIRCRAFT LANDING ALTIMETER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention makes use of a sensitive differ-ntial pressure gage to drive a pointer over a dial which calibrated in height above touchdown. The dia-hragm of the gage is subjected to equal pressure inside nd out until the aircraft arrives at a known height bove touchdown as, for instance, the intersection of a lide slope axis and a marker beacon. At this known eight above touchdown the existing static pressure ithin the case of the sensitive differential pressure age is maintained by instantly closing off access to at-ospheric pressure. The diaphragm interior is subject the increasing static pressure of the atmosphere as loses altitude to the runway touch down zone. This hange of differential pressure becomes a measure of titude change and is indicated on the altimeter dial.

2. The Prior Art

The only authorized landing altimeters for aircraft cognized by the Federal Aviation Administration are dio altimeters. Their use and characteristics are de-ribed in FAA Advisory Circular, AC No. 120–28A ated Dec. 14, 1971. Two are required and those ac-eptable are very costly and subject to error of plus/-inus five feet.

Heretofore barometric altimeters which utilize an acuated aneroid diaphragm have been employed in any arrangements for indicating altitude. These pes, due to the employment of evacuated diaphragms e subject to errors of structure such as hysteresis, me-anical error, friction error, scale error and setting er-r. The latter error can involve error on the part of the rcraft pilot or be part of the ground personnel in ansmitting the altimeter setting to the pilot by radio, a combination of both. One example of the effort to cure accurate setting of an aneroid type of altimeter shown in U.S. Pat. No. 2,167,412.

A ground proximity indicator that utilizes the so-lled ground effect noticed in landing a fixed wing air-aft is described in U.S. Pat No. 3,348,412. A differen-l pressure gage is utilized to obtain an indication of ound proximity by sensing both a static pressure low the wing and above on the fuselage, hardly meet-g a requirement for altitude information from 0–200 feet altitude to touchdown.

SUMMARY OF THE INVENTION

The instant invention utilizes the difference of tatic) atmospheric pressure between known levels, mely between the runway touchdown point and a int on the glide slope where it intersects a marker acon, either inner, middle or outer, or at any other entifiable point on the glide slope such as can be es-blished where a VOR radial intersects the glide slope diated space pattern. Since marker beacon intersec-n defines a distance from touchdown, suitable preci-n DME (distance measuring equipment) can manu-y or automatically signal the passage of a known ight/distance to start operation of the landing altime-. Since the glide slope path is well defined in space, ually having an angle of 2.5 to 3.5 degrees with the rizontal it is only necessary to know the distance to

touchdown in order to determine the height above it an an identifiable point on te glide slope.

In this invention a differential pressure gage of high sensitivity is arranged to retain on the outside of the re-laxed diaphragm the atmospheric pressure existing at the reference height above touchdown as the aircraft passes the reference height while allowing the building pressure within the diaphragm to indicate the altitude change to touchdown. Since the time involved during the aircraft passage of say the middle marker to touch-down is a matter of seconds there can be no apprecia-ble barometric change to affect the accuracy of mea-surement of the pressure difference.

The convenience of using the marker beacon signal to actuate the altimeter makes for simplicity and accu-racy and only requires the use of already installed equipment in most aircraft. It is this signal which ener-gizes a solenoid to close the access port of the differen-tial pressure gage low pressure side to atmospheric (static) pressure at the programmed height above touchdown.

Accordingly it is an object of this invention to pro-vide a landing altimeter for aircraft that uses existing atmospheric pressure difference between a known ref-erence point above the touchdown zone and the touch-down zone.

It is another object of this invention to provide means for compensating the altimeter reading to provide for variations of aircraft flight path above or below the glide slope path.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is the indicating face of one form of the land-ing altimeter.

FIG. **2** is a cutaway schematic side view of the altime-ter of FIG. **1**.

FIG. **3** depicts glide slope and marker beacon space patterns in relation to a runway touchdown zone and adjacent terrain.

FIG. **4** is a schematic portrayal to describe function of the altimeter.

FIG. **5** is an exploded view of part of the indicating bezel of the altimeter.

FIGS. **6**, **7**, and **8** indicate exemplary indications of a glide slope pointer and associated localizer pointer.

FIG. **9** depicts dimensional elements of glide slope and marker beacon space patterns.

FIG. **10** depicts schematic arrangement of the remote indicating form of the landing altimeter.

FIG. **11** shows partial cutaway detail of structure of landing altimeter for remote indication.

FIG. **12** is a sectional view taken of the altimeter on line **2**—**2** of FIG. **11**.

FIG. **13** is a partial side view of the brake mechanism of FIG. **11**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The aircraft landing altimeter of the present inven-tion can best be described by reference to the drawings.

In the preferred embodiment there are two forms, one the direct reading form shown in FIGS. **1**, **2**, **4** and **5**, and the other the remote reading form as depicted in FIGS. **10**, **11**, **12** and **13**.

In the direct reading form, reference is made to FIGS. **1**, **2** and **4** in which the numeral **10** is an adjustable dial swept by a diaphragm driven pointer **11**. The dial **10** is fabricated of glass or clear plastic and has the numerals that display height above touchdown, and the associated scale marking, delineated on the underside of the circular dial. The dial **10** is positioned beneath the holding clips **12** and **12′** for adjustment in either clockwise or counterclockwise movement. The nominal height above touchdown of the glide slope axis at the inner marker IM (FIG. 3) is 100 feet and this is the established equipment of CAT II (Category II) ILS (instrument landing system) runways. In the event it is desired to establish the reference altitude as 200 feet above touchdown the middle marker (MM) position along the glide slope would be selected and the scale on the dial would be expanded accordingly. For purpose of description herein below the 100 foot altitude above touchdown zone calibration is selected.

In order to understand the structure and function of the landing altimeter reference is made to FIG. 3 in which is shown the related radiated space patterns of the conventional glide slope transmitter and two of the three marker beacons associated with the ILS which also includes a localizer transmitter whose space pattern is used to provide lateral guidance to the runway and along its centerline. As noted in FIG. 3 the inner marker is positioned so that its center line (nominally) intersects the glide slope at a point 100 feet above the touchdown zone of the runway. In practice this height varies so that at the San Antonio CAT II runway this intersection is actually 108 feet above the touchdown zone. Accordingly the dial **10** of the instrument may be rotated counterclockwise until the value of 108 feet appears above the pointer **14** preparatory to beginning the approach/landing.

The glide slope radiated space pattern is so designed that (FIG. 9) its "thickness" at the inner marker is 52 feet. This means that the deflection shown in FIG. 7 of the glide slope pointer indicates that the aircraft is two dots, or 26 feet below the glide slope. Most instrument rated pilots can keep the aircraft within a quarter dot (3–4 feet) plus or minus of the glide slope centerline at a selected instant while flying manually. Under automatic (coupled) approach control the accuracy should be within one and one-half feet plus or minus of the center line. The accuracy noted above for manual controlled flight has been checked experimentally in flight.

However, to be described below, means are provided to automatically compensate the landing altimeter indication for position error, above or below the glide path.

Since the function of the landing altimeter is dependent upon atmospheric pressure, which is known to vary at different elevations above sea level, and to vary at the same elevation at different times, consideration of this phenomenon must be given in so far as practical usage of the altimeter is concerned. For purpose of illustration it will be assumed that standard sea level pressure (29.92″of Hg) exists at a sea level airport at the location of the inner marker where as noted above the glide slope axis is 108 feet above the marker. Now if the barometer should fall suddenly to a value of 28.92 during the nine second interval between passage of marker to touchdown, a highly improbable circumstance, the pilot would be confronted with a two foot

error of altitude, about the same error he would
rience if he landed at an airport a thousand feet
than sea level without a change in barometric re
If he flew from the sea level airport to land at one
7000 feet (Colorado Springs) an error of ap
mately 14 feet would be encountered, assuming
dard barometric pressure existed there. So if the
landing altimeter was calibrated for a median al
of say 3500 feet above sea level the greatest exp
error would be approximately plus or minus 7 feet
error is less than that claimed for some expensive
temporary radio altimeters.
Nevertheless altimeter setting data would be
lated on the "approach plates" (FAA approved i
ment landing data) for each airport as is now sta
procedure to include HAT (height above touchd
which would include the standard atmosphere val
the airport. In other words atmospheric pre
changes except those encountered in the violent o
nado type of weather would have little practical e
on the accuracy of the present invention.
The sensitive differential pressure gage A consi
a pressure tight case **14** with a metallic connecting
15 which leads to an elastic tube **16**, which in turn
nects with the metallic tube **17** (FIG. 2) which
nects to the diaphragm **18**. The tube **17** is pre
sealed where it passes through the case wall **19**
tube **17** has another branch **20** which leads to an e
nal source of static pressure about the aircraft. Ac
ingly the same normal static pressure exists in the
the diaphragm and interconnecting tubes at all
except when the solenoid **21** is activated at passa
the marker beacon to clamp off and hold the
pressure within the thermally insulated case whil
mitting an increase in static pressure, attending l
ing of height, within the diaphragm. This chan
pressure difference is indicated as noted above o
indicating face of the instrument. Normally the
sure differential experienced will amount to abou
inches of water, when the inner marker is the refe
or 2.88 inches of water when the middle marker
reference.
FIG. **4** is a schematic presentation of the direc
cating form of the invention which shows the com
function of a moving aircraft along a glide slope
nating from a ground based glide slope transmitte
received by an associated airborne glide slope rec
22, an associated ground based marker beacon
mitter and an airborne marker beacon receiver **23**
latter causes the selected (middle or inner) m
lamp circuit, in this explanation the inner marker
circuit, to energize the holding relay **24**, which i
energizes the solenoid **21** to clamp the tube **16**
main switch **25** and the sensitive circuit break
must of course be closed in order for the operat
take place. With these switches on, the pilot lig
will be illuminated. When the marker is passed t
propriate lamp in the receiver panel **28** will flash,
the marker lamp **29** on the face of the instrumen
remain on to show closure of the solenoid and he
confirm operation of the instrument. The syste
mains "ON" until landing and turn off a main s
or "missed approach" with attendant altitude c
which will cause the diaphragm switch **30** to ac
the circuit breaker **26** which will de-energize the
noid **21** permitting the differential pressure to ret
normal static pressure and allowing the holding

solenoid to return to
cuit breaker **26**. The ci
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tment **31**; the circuit br
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he diaphragm switch **30**
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front bezel of the instr
s **32** (FIG. 5) through
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e diaphragm mechanis
of the cover glass **32** is
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on (FIG. 5) upon whicl
g dial **10** which is frict
g clips **12** and **12′** of
make use of the direc
ion the knob **13** is used
the pointer rests unde
e touchdown value) fc
d above this value will
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e touchdown point and
s the *median* barometr
corrected to sea level
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t the altimeter reading/
at of the glide slope a
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as noted in FIG. **10**.
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touchdown to touchd
be used alone, or in an
with the microammeter
3,292,176 and U.S. Pa
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represented by C or C
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horizon line or zero po
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hes the touchdown po
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microammeters referen
the photovoltaic cell
he lamp **39**. One shu
r **41** of the sensitive dif
ucture and function o
to that shown in FIGS.

and solenoid to return to "ready" after re-setting the circuit breaker 26. The circuit breaker 26 and related wiring is located in an integral but separate case compartment 31; the circuit breaker plunger 26' is located (FIG. 1) in the face of the instrument. This plunger may be hand actuated to open or close the circuit breaker.

The diaphragm switch 30 also serves to guard the diaphragm against any inadvertent over or under pressure. The front bezel of the instrument is sealed by the cover glass 32 (FIG. 5) through which may be seen the indicating pointer 11 which sweeps over a blank dial, except for the (FIG. 1) two arrows 33 and 33' which establish the "zero" position of the pointer, and consequently the relaxed diaphragm position. These arrows insure that no friction or other mechanical error exists in the diaphragm mechanism. Bonded to the outer surface of the cover glass 32 is the irregular mask 34 which serves as a name and instruction surface. Immediately above this mask is a thin ring gasket 35 composed of Teflon (FIG. 5) upon which rests the transparent indicating dial 10 which is frictionally held in place by the spring clips 12 and 12' of FIG. 1.

To make use of the direct indicating form of the invention the knob 13 is used to rotate the indicating dial until the pointer rests under the selected HAT (height above touchdown value) for the point of landing. As noted above this value will reflect the algebraic sum of the surveyed height of the glide slope above the level of the touchdown point and a correction value that reflects the *median* barometric (standard atmosphere) value corrected to sea level.

Each aircraft installation will require calibration to adapt the altimeter reading/setting depending upon the height of the glide slope antenna above the landing wheels at touchdown. In tremendously large aircraft (C-5) the 200 foot middle marker calibration would probably be used.

Since vertical wind shear or inexact flying may be encountered as the aircraft passes the selected marker beacon locus it may be desirable to use the remote reading form of the preferred embodiment of the invention which is illustrated principally in FIGS. 10 to 13 inclusive. It will be noted that both forms employ the structure and principle of operation but provide means for remotely locating the indicating scale or scales as noted in FIG. 10. The remote indicator B is a vertical scale microammeter the scalar value of which represents 100 feet of height change from 100 feet above touchdown to touchdown point. This indicator could be used alone, or in an electrical parallel arrangement with the microammeter described in my U.S. Pat. No. 3,292,176 and U.S. Pat. No. 3,307,191, which allows the dual employment of the glide slope pointer as is represented by C or C' of FIG. 10. In this case the rising pointer 36 will move from the 100 foot value to the horizon line or zero position as the pointer 37 of C moves downward from 100 to 0, as the aircraft approaches the touchdown point from its position over the inner marker.

In order to secure this remote indication on either or both microammeters reference is made to FIG. 10 in which the photovoltaic cell 38 is energized by light from the lamp 39. One shutter 40 is attached to the pointer 41 of the sensitive differential pressure gage 42 the structure and function of which is alike in all respects to that shown in FIGS. 1, 2 and 4. Another shutter 43 is attached to the pointer 44 of a glide slope microammeter 45. With the differential pressure at zero, such as when the aircraft has not yet reached the selected marker beacon but is on the glide slope (FIG. 6) both the above shutters are positioned as shown in FIG. 10 and FIG. 12. Under this condition the lamp 39 whose voltage is controlled by the voltage regulator 46 partially illuminates the photocell to produce a reading of 100 feet on the meters B and C. At the instant of passage of the selected marker beacon should the aircraft be two dots low as indicated in FIG. 7 the shutter 43 would move counterclockwise to cast a shadow on the photocell along a light ray D from the lamp 39 which would produce an indication of 74 feet on the remote indicating meters. The value of height so established at passage of the marker is the fixed maximum indication because at instant of passage, where the solenoid closure valve 47 is triggered (FIG. 10), so is the meter brake 48. This holds the shutter 43 in position since the glide slope correction pointer 44 must be held in reference position.

In the event the aircraft should be two dots high at time of marker passage, the static pressure differential noted at touchdown would be that associated with a pressure change responsive to 126 feet. Accordingly each meter B and C would, if calibrated say to 200 feet, show this indication. In the instant example then the pointer of meter 45 would move clockwise and be braked on marker passage at light ray E from the lamp 39. In this case the instrument would begin to read a lowering height when the aircraft passed through the 100 foot height above touchdown. It will be noted that this extreme deflection of the shutter 43 is shown in FIG. 10 at 43'. The shutter 40 would also then move to the light ray E to signify reaching touchdown height.

The aircraft precisely following the glide slope will insure that the meter pointer 43 and associated shutter is as shown in FIG. 10, at instant of marker passage and the differential pressure gage pointer 41 and its associated shutter 40 along light ray F is also as shown in FIG. 10. At the instant of passage of the marker the shutter 40 begins its move to the touchdown position and the light striking the photocell is then completely shadowed along the light ray G, from the lamp by shutter 40' to produce the zero indication at touchdown.

The structure just described with reference to the schematic presentation of FIG. 10 will find its counterpart in FIGS. 11, 12 and 13. It will be noted that the diaphragm type of sensitive differential pressure gage 42 is fitted with a pressure tight transparent cover 49 which is bonded to a transparent closed cylindrical cupola 50. Extending upwardly through an aperture in the cover glass into the cupula is the pointer/shutter structure 51 which is fixed to and driven by the diaphragm movement of the differential gage as is well understood in the art. A lower sub-case 42 contains the clamping solenoid 52 which when activated seals the static pressure within the case 42 while permitting changing static pressure to reach the diaphragm interior through the static line 53 which connects with the static source of the aircraft.

Contained within the housing 54 and fixed to the upper part of it by means of screws 55 and 56 is a glide slope microammeter movement 57 which drives the pointer/shutter structure 58. The pointer shaft is concentric with the shaft 59 of the differential pressure gage and the shutter 43 sweeps concentric with and outside of the cupola **50** which contains the pressure sealed-in lamp **39** which is activated when the relay **60** activates the solenoid **52** and its associated valve **47.**

The housing **54** also supports the photocell **38** by means of a tubular brace **61** which serves also to house the photocell electric leads that are connected to the indicating meters. To avoid confusing the drawings all electric wire leads are eliminated as their function is explained. The housing may be rotated from its position shown in FIG. **12** where a pointer **62** indicates the nominal height above touchdown at the inner marker. Turning this housing clockwise displaces the photocell locus *and* the shutter **43** (as well as the glide slope meter itself) through an equal angle. This in effect moves the touchdown zero light cutoff to accommodate a higher setting at marker passage as for instance 110 feet as noted on the scale **63.** Opposite rotation of the housing causes early cutoff of light to photocell exemplified by lower pressure difference and hence smaller travel of the shutter **40.** The spring clips **64** and **65** hold the lip **66** of the housing **54** which has its lower opening seated on the cover glass around an annular guide ring **67.**

The brake mechanism (FIG. **13**) consists of a spring **68** (non-ferrous) which has one end anchored by rivet **69** to the bracket **70** which supports the electromagnet **71** whose case attracts the armature **72** of the spring **68** to cause the friction tip **73** to hold the armature of the glide slope meter from rotation until holding relay **60** is released by deactivation of the control circuit.

In order to eliminate temperature compensation structure, normally a part of a sensitive differential pressure gage, as well as to insure that all parts, including the trapped volume of air within the gage case (and any extension of it) is maintained at a constant temperature, the thermostatically controlled heater unit **74** of any suitable design, well known in the art, is included in that thermally insulated case portion containing the sensitive diaphragm and connected mechanism. The controlled temperature will be that at which experience shows is the maximum ambient temperature to which the gage would normally be subjected in service.

Although the present invention has been described in connection with the preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. For example, there are many types of pressure sensors which could replace the metallic diaphragm of the gage, one being for instance a special elastomer similar to that used in the familiar Dwyer magnahelic differential pressure gage.

I claim:

1. In an aircraft height-above-touchdown indicating system, a differential pressure gage having an indicating pointer positioned adjacent a rotatable dial calibrated in units of height,

an aircraft supporting said differential pressure gage,

a marker beacon receiver supported within said aircraft,

a glide slope receiver supported within said aircraft for the purpose of providing glide slope guidance to the pilot of said aircraft,

a flexible wall diaphragm supported within said differential pressure gage case,

said case having airtight construction with an outlet,

said outlet connected by a tube leading to the interior of said diaphragm,

said tube having a flexible portion and provided with a T-connection having a first branch leading to the static pressure system of sair aircraft in order to provide equal static pressure to said case interior as well as to the interior of said diaphragm;

a solenoid positioned adjacent said flexible portion of said tube, said solenoid having a moving armature extension arranged to clamp said flexible portion at a locus between said outlet of said case and said T-connection; and

electric relay and switching means for activating said solenoid when said aircraft supported beacon receiver is activated in response to a ground based marker beacon transmitter, linkage mechanism between said flexible diaphragm of the differential pressure gage and said indicating pointer to activate said pointer at the activation of said marker beacon receiver in order to indicate differential pressure change as a function of changing height of said aircraft with relation to the static pressure extant within said airtight case of said differential pressure gage after activation of said solenoid.

2. The system of claim **1,** with associated radio marker beacon receiver and associated glide slope receiver and with electro-mechanical valve means for selectively maintaining static pressure within said case of said differential pressure gage, a ground based glide slope transmitter,

relay means for controlling said electromechanical valve means in response to energy impulse output from said marker beacon receiver,

an associated ground based marker beacon transmitter selectively co-located along the transmitted space pattern of said glide slope transmitter in order to define a locus in space above an aircraft landing runway that defines the locus of activation of said electromechanical valve means in order to maintain in said case the atmospheric static pressure existing about said aircraft upon closing of said electro-mechanical valve,

and a photocell,

a lamp source of illumination,

a moving arm made responsive to movement of said diaphragm,

a shutter means attached to said moving arm for controlling the amount of light reaching said photocell from said lamp and electric meter means for indicating said photocell current, and

said meter means calibrated in units of height proportional to the differential pressure existing in said differential pressure gage.

3. The system of claim **2,** having a zero-center electric meter having a pointer supported shutter, said shutter co-located with the shutter supported on the driving arm of the diaphragm of the differential pressure gage,

said zero center electric meter made responsive to the output of said glide slope receiver in order to vary the exposed sensitive area of said photocell to the light source in proportion to the positive or negative current flow through said zero center electric meter, the current being proportional

the aircraft position

brake means for holdi
zero center electric r

the aircraft position with respect to the glide path,

brake means for holding the instant position of said zero center electric meter movement at the time of

activation of the electromechanical valve, and

means for relasing said brake means upon deactivation of the electromechanical valve.

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