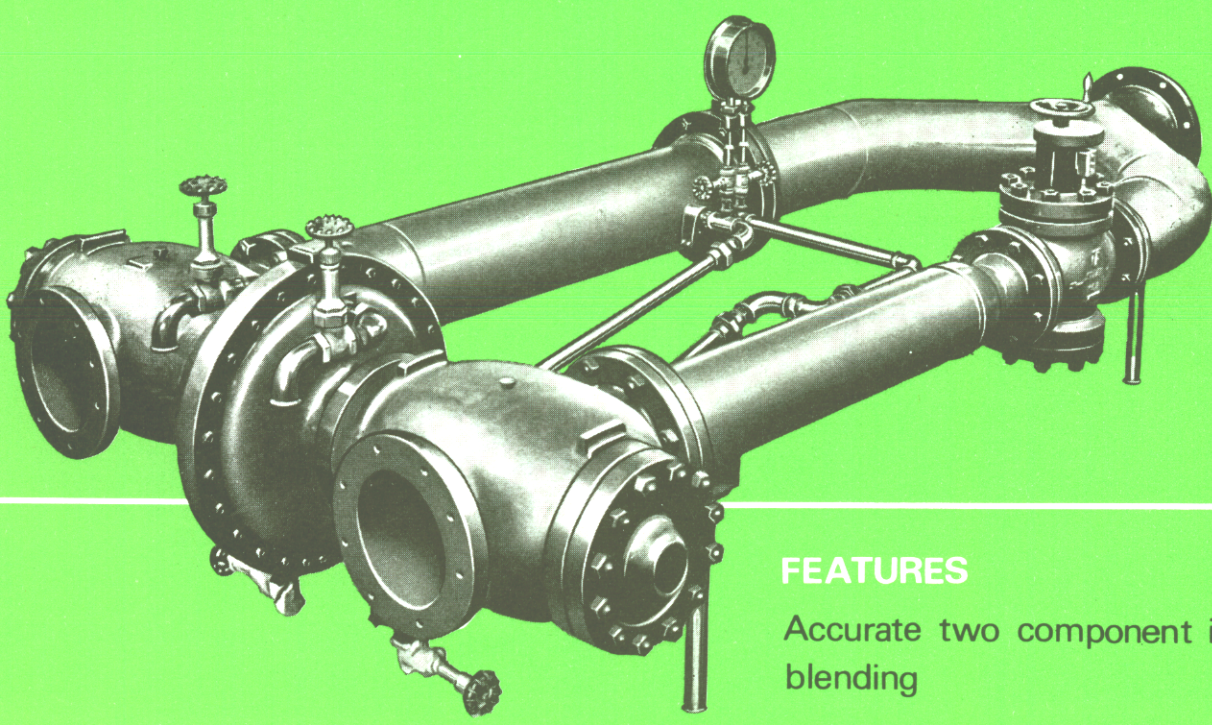
# BLENDING UNITS



## FEATURES

Accurate two component in–line blending

No auxiliary services required

Robust

Little maintenance skill required

Better service from bunkering installations

Mobile units available

Hallikainen

These devices have been developed for the in-line blending of intermediate grades of fuel oil. Each unit operates as a volumetric proportioning device by maintaining the same differential pressure across two orifices so that variation in volumetric ratio is attained simply by changing the orifice area ratio. They are robustly constructed and can be built directly into a pipeline system or mounted on a trailer and connected by hose. Fuel oils having viscosities, at pumping temperature, up to 4000 sec. Redwood No.1 may be handled.

## PRINCIPLE OF OPERATION

In Fig.1, the two oils which are to be blended in specific proportions are pumped through pressure equalising valves A1 and A2 the function of which is to maintain equal pressures at the points B1 and B2. It will be noted that these two valves have a common spindle sliding on ball bearings with a balancing diaphragm C attached to the spindle and acting as a seal between the two valve bodies.
The pressures at points B1 and B2 are transmitted to each side of the diaphragm. If the pressure at B1 tends to increase over that at B2, the diaphragm moves the spindle to increase the area of valve A2 (while reducing that of valve A1) until the two pressures are once more in balance.




**Fig.1** **Schematic arrangement**

The two oils then flow through fixed orifice D and variable orifice E to a mixing vane at the outlet F. As the pressure at F is common to both flow streams and as the upstream pressures at B1 and B2 are balanced, the ratio of flow through the orifices D and E will be directly proportional to their respective areas. By adjusting one in relation to the other it is thus possible to set the required blend ratio.

In order that this ratio shall be maintained with reasonable accuracy, steps must be taken to minimise the effects of viscosity variations at different flowing temperatures. The viscosity of fuel oil of 3500 sec. Redwood No.1 or more will vary greatly with change of temperature. The heavier oil is therefore passed through an orifice of a special design which provides a reasonably constant discharge coefficient even though the viscosity changes significantly.* The ratio of blending is then adjusted by regulating the flow of the lighter component through a variable orifice E which takes the form of a specially designed metering valve (Fig.2).

A setting chart provided with each unit gives the valve setting for any required blend, when the specific gravity at flowing temperature of each constituent fuel is known. The valve setting may readily be made by a handwheel. Piston position is given on a 3-digit counter on the assembly. The normal range for the blender is designed to comply with usual bunkering demands and to be sufficiently wide for all practical purposes. (See Specification).

*WITTE: 'The Measurement of the Flow of Viscous Fluid by Differential Pressure Methods' *Z.V.D.I.*, 15 May 1943.

## ADVANTAGES

No auxiliary equipment or services such as electricity or compressed air are needed. The unit is entirely self-acting.

It is robustly built and is capable of withstanding shock pulsations from reciprocating pumps.

No particular maintenance skill is needed. Provision of means for flushing and draining are incorporated.

It enables bunkering installations to provide better service and wider range of oils without expensive storage tanks, or the need for recirculating equipment.

Ensures accurate gross tonnage of final blend.

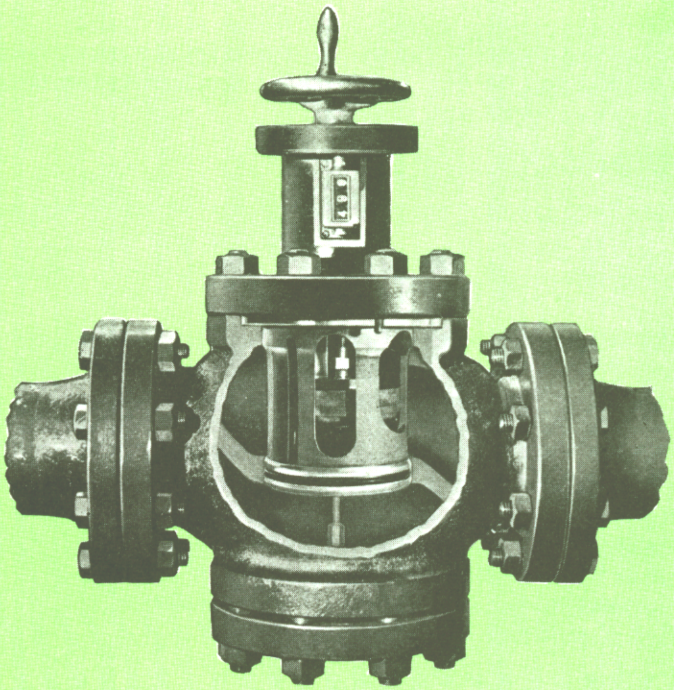


**Fig.2 – Detail of Metering Valve showing handwheel, counter and piston type valve plug.**

**BLENDING UNITS**

## TYPICAL APPLICATIONS

In-line blending direct to ship's bunkers.

In-line blending direct to bulk lighters or small craft.

In-line blending direct to road or rail vehicles.

In-line blending direct to a tank through the normal connections and without re-circulation.

## SPECIFICATION

**Pressure equalising valve:** Double Ported design 'A' bodies; stainless steel trim; fully balanced piston type inner valve, screwed in seat rings; diaphragm assembly fitted with reinforced Neoprene diaphragm. Maximum pressure 150 lb in$^2$. Maximum temperature 150°F. 1in impulse and purge connexions.

**Blend adjustment valve**: Type 1500 – Single Ported design 'A' body, stainless steel trim; taper plug valve plug, top and bottom guided; screwed in seat rings; micrometer setting scale on yoke.

Type 1502-7 – Modified Single Ported design 'A' body, with piston and sleeve type valve plug; sleeve – cast iron; piston – mild steel piston ring – phosphor bronze; piston rod – stainless steel; handwheel fitted with 3-digit counter to indicate piston position.

**Orifice plate:** Stainless steel with anti-air lock bleed hole. Daniel Junior Orifice fittings are also available for some sizes. Details on application.

**General:** Mild steel connecting piping to API Spec.5–L Grade A or B with flanges to ASTM Spec.A181; mixing vane in outlet flange; mild steel impulse piping fitted with flushing taps, isolating valves and 6in dial differential pressure gauge; three welded on supporting feet for fixed unit. Mobile units can be supplied with two or four wheel trailers equipped with stabilizing jacks.

**Construction materials**

**Iron**

H.T. iron equalising valve bodies, diaphragm assembly, blending valve body and yoke.

**Steel**

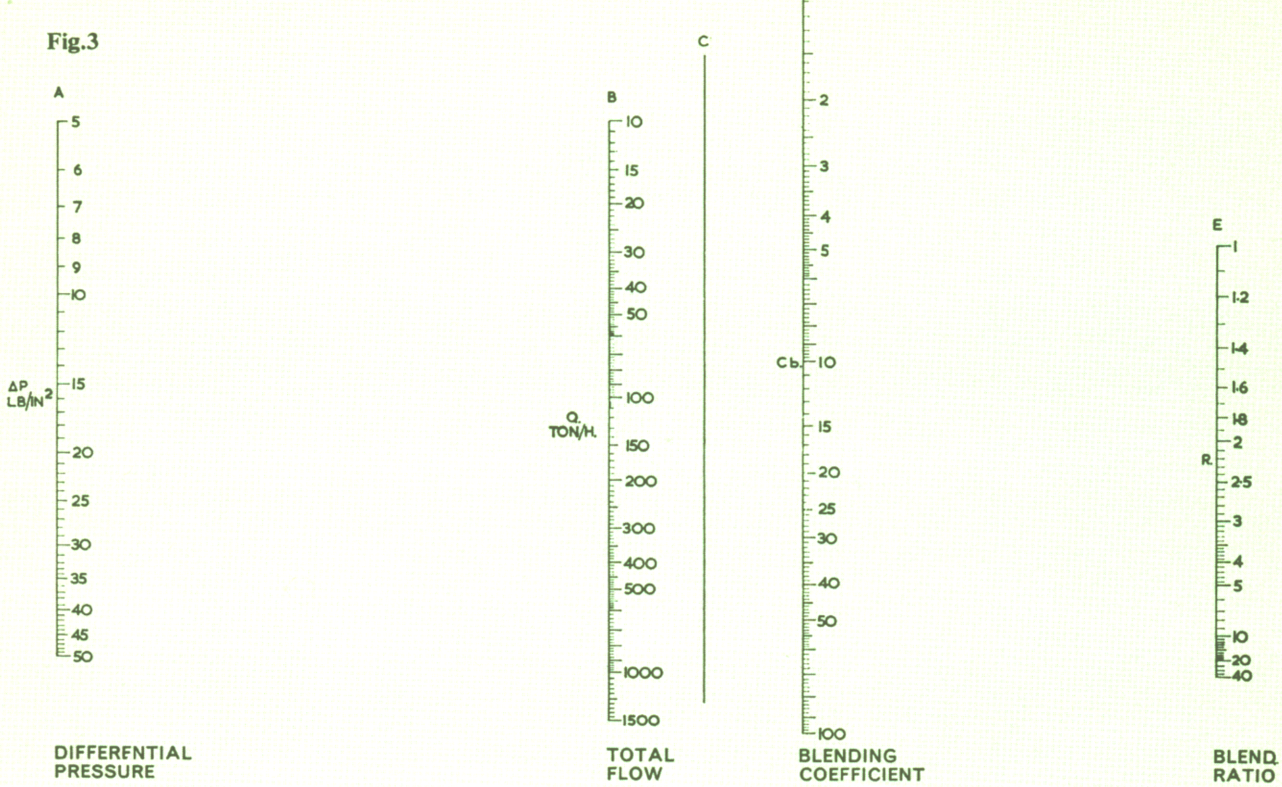
Carbon steel equalising valve bodies, diaphragm assembly, blending valve body and yoke.

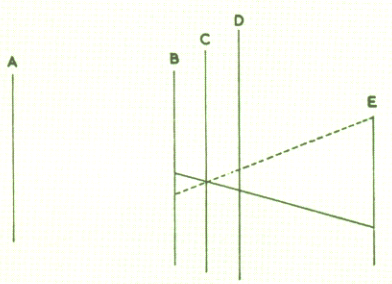
**Extra Equipment**: Bulk Meters which are available for either inlet or outlet connections, provide facility for simultaneous metering and blending.
Tight shutting butterfly valves can be fitted allowing the unit to remain primed between operations.
Large mobile units can be supplied with a removable davit. This may be fitted up at either end of the decking for hoisting hose pipe connections up to the level of the unit's flanges.
Connections are normally flanged ANSI 125 or 150 but adaptor spools can be supplied to suit other flange specifications.
Strainers, thermometers and further isolating valves to permit single leg pumping, can be fitted to suit customers particular requirements.

| Type | Material | Inlet sizes inch | Metering valve size inch | Fixed orifice size inch | Outlet size inch | FLGD ANSI | Ratio of Blend min. | Ratio of Blend max. | Approx. nett weight tons |
|---|---|---|---|---|---|---|---|---|---|
| 1500 | Iron<br>Steel | 3 | 2 | 1⅓ | 4 | 125<br>150 | 1:1 | 10:1 | ½ |
| 1502 | Iron<br>Steel | 6 | 4 | 2⅔ | 8 | 125<br>150 | 1:1 | 20:1 | 1¼ |
| 1504 | Steel | 8 | 6 | 3⅓ | 10 | 150 | 1:1 | 20:1 | 1¾ |
| 1505 | Steel | 10×3 | 2 | 5 | 12 | 150 | 14:1 | 140:1 | 2¼ |
| 1506 | Steel | 10×6 | 6 | 4 | 12 | 150 | 1½:1 | 32:1 | 2½ |
| 1507 | Steel | 10×8 | 6 | 5 | 14 | 150 | 2¼:1 | 45:1 | 2¾ |

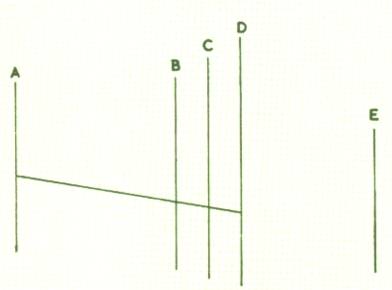
## BLENDING UNIT CAPACITY CHART

**Fig.3**




STEP 1




STEP 2

**Instructions for using chart**

This chart is for determining capacities of all Hallikainen series blending units. When assembling data for use with this chart, the units of pressure and flow must correspond to those shown on the chart.

**Procedure:** To determine the sizing coefficient when the known values are blend ratio (heavy/light by weight), total mass flow in ton/h and the pressure loss across the unit in $lb/in^2$, proceed as follows:

**1** If the blend ratio is other than 1, correct the given rate of flow by the following method:

**(a)** Lay a straight edge on the flow rate on scale 'B' and the blend ratio on scale 'E' and mark the point of intersection with line 'C'.

**(b)** Pivot straight edge on point of intersection on line 'C' to 1 on blend ratio scale 'E' and read off corrected flow rate on scale 'B'.

*Note:* If the required blend ratio is 1 then omit step 1 and locate the flow directly on scale 'B'.

**2** Lay the straight edge on the differential pressure scale 'A' and the corrected flow rate on scale 'B' and read off the blending unit sizing coefficient on scale 'D'.
From the blending unit sizing coefficient table on the right, locate the nearest higher sizing coefficient (Cb). This will give you the blending unit size required to fulfil the given conditions.

### NOMOGRAPH EQUATION

$$Q = Cb\sqrt{\Delta P}\left[1+\frac{1}{R}\right]$$

where:

Q = Total mass flow in ton/h.

$\Delta$P = Pressure loss across the unit in $lb/in^2$.

R = Blend ratio (heavy/light by weight)

Cb = Sizing coefficient.

| Cb values for type 431 series Blending Units | |
|---|---|
| Unit size inch | Cb Value |
| 3 | 6 |
| 6 | 23 |
| 8 | 37 |
| 10 × 3 | 80 |
| 10 × 6 | 50 |
| 10 × 8 | 80 |

## DIMENSIONS

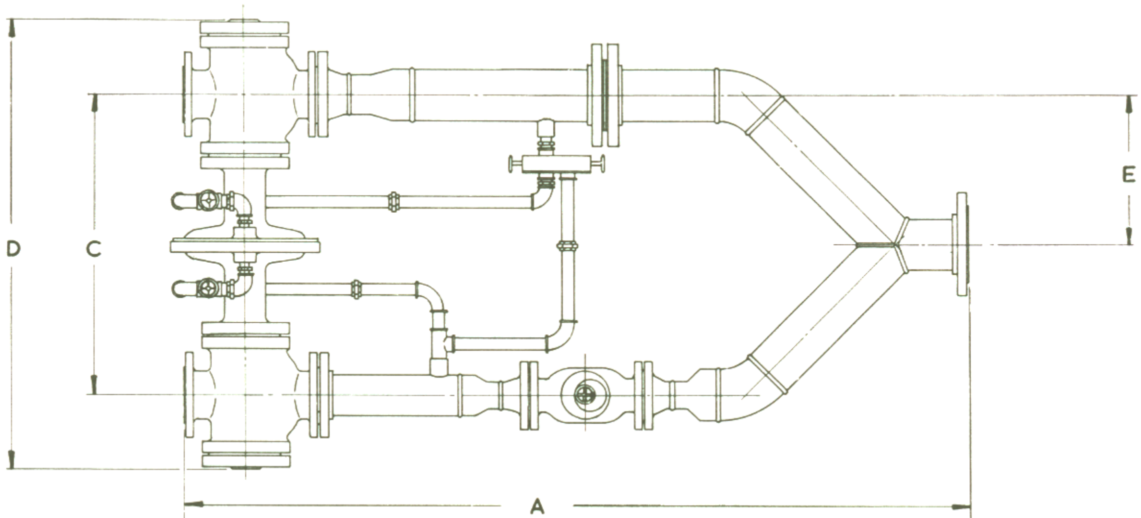



Fig.4

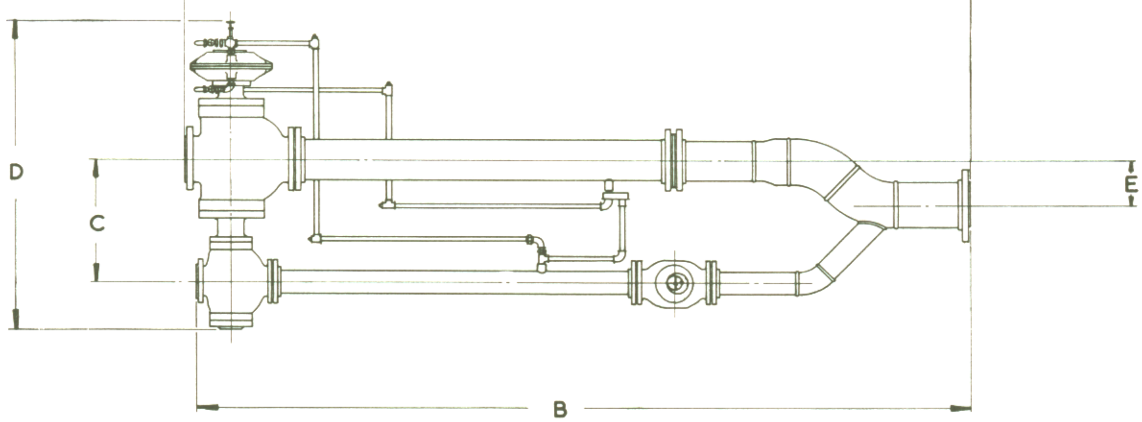



Fig.5

| Basic Unit | | | | | | | with Bulk Meters |
|---|---|---|---|---|---|---|---|
| Size | Fig. | A | B | C | D | E | A |
| 3 | 4 | 68½ | — | 26¼ | 40½ | 13⅛ | 101½ |
| 6 | 4 | 121¼ | — | 33 | 57½ | 16½ | 167 15/16 |
| 8 | 5 | 189⅛ | 189⅛ | 30 | 76 | 8¾ | 237¾ |
| 10×3 | 5 | 191 | 185¼ | 25 | 69 | 10¾ | 246½ |
| 10×6 | 5 | 191 | 187¾ | 30 | 79 | 10¾ | 246½ |
| 10×8 | 5 | 213⅛ | 211⅝ | 31 5/16 | 79 | 12⅜ | 268½ |

All dimensions are in inches and are subject to change without notice

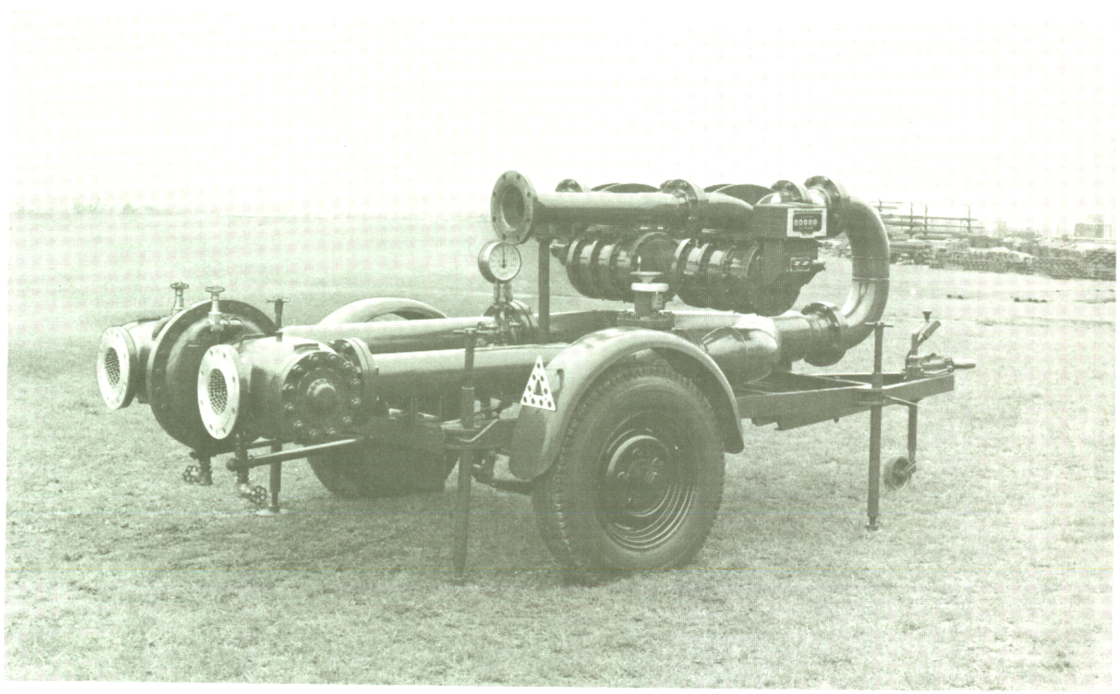


**Fig.6** 6 x 6in Blending Unit with Bulk Meters on outlet connections. This illustration shows compact method of mounting the unit on a two wheel trailer, and also the strainers in the inlet connections.

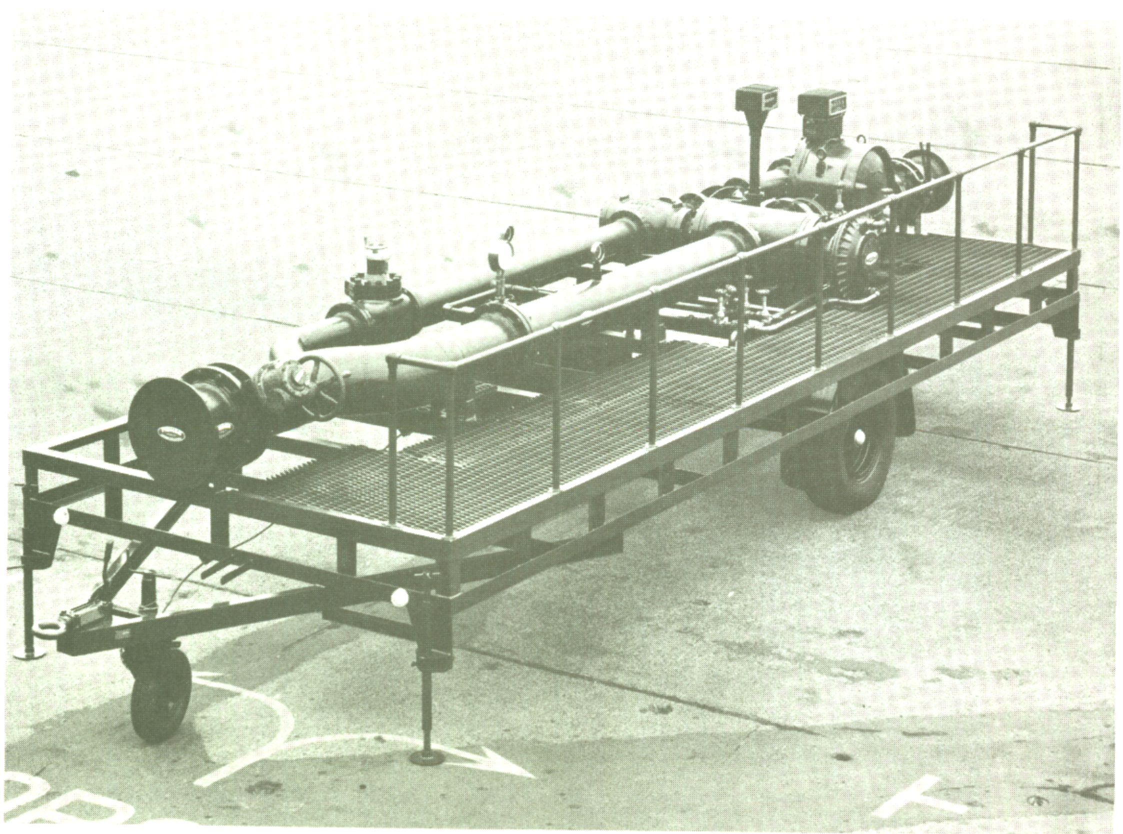


**Fig.7** 10 x 6in Blending Unit with Bulk Meters on inlet connections and manually operated rubber-lined Continental Butterfly valves on inlet and outlet connections. Note that Bulk Meter indicators, thermometer dials, and differential pressure gauge can be seen, and all adjustments made, by an operator on trailer decking.
Two wheel trailer facilitates manoeuvring in limited space.

## ORDERING INFORMATION

1. Flow (Volume or weight per unit time)
2. Allowable Pressure Drop
3. Ratio of Blend (Maximum Minimum)
4. Component Characteristics (S.G. @ 60° F. Viscosity @ 100° F.)
5. Mobile or fixed unit
6. Flange ratings if other than standard
7. Extra Equipment required

*Acknowledgment is made to the Shell Petroleum Co. Ltd. for their collaboration in the development of this design and for services made available by Shell-Mex and B.P. at one of their installations for performance and calibration tests.*

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