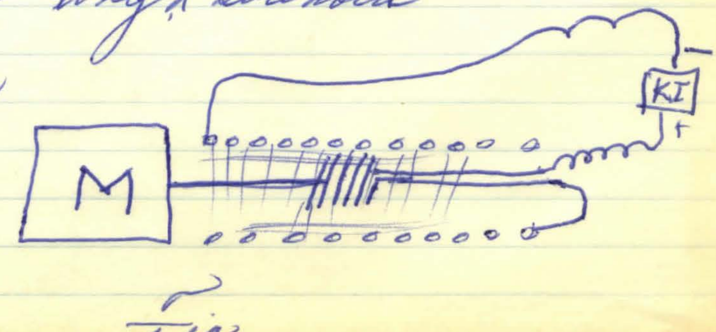
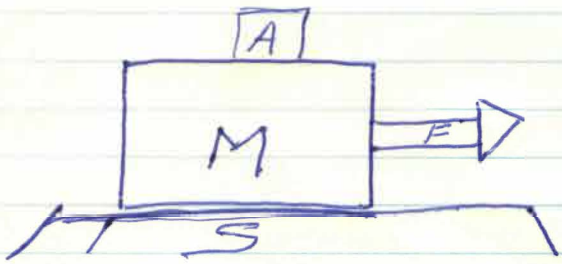
$M = \frac{F}{A}$

~~One of the~~ An apparently simple method of mass determination would require only a constant force c̄ measurement of the acceleration produced. A variety of forces are available but ~~not~~ all are only relatively constant. Some of the available constant force ~~generators which could~~ are gas jets, constant force springs, ~~and~~ electro-magnetic and constant pressure gas ~~cylinders~~ pistons. It will be assumed that the final velocity obtained is low and that acceleration is small. It is difficult to put performance values on the various methods but on electro-magnetic scheme would probably be ~~useful~~ the most accurate force arrangement, especially for small forces. ~~Such~~ Fig. — shows one possible arrangement in which a long accurately wound solenoid develops a constant magnetic field. In series c̄ this long solenoid



Fig

A schematic of this arrangement is shown in Fig I.



~~The app~~

M is a mass ~~supported &~~ constrained to move along ~~in~~ a single ~~given~~ axis by the support S. This constraint ~~device~~ ~~must~~ should be frictionless ~~and at~~ or at least must have a constant coefficient of friction. ~~2~~ A constant force F is applied and will be balanced by a number of other forces including the desired inertial force, wind drag, ~~and~~ inertial force from "trapped" air, ~~an~~ ~~resistance~~ resistive forces from any mechanical drag of the ~~re~~ restraining arrangement, ~~and~~ if the body is non rigid complex forces from "slosh" of the movable portions and the effects ~~of~~ any internal force generators ~~are~~ present such as the heart in humans. ~~Note~~

Acceleration may be measured directly from

an accelerometer mounted on the mass. ~~or~~
A ~~more~~ more practically alternative to the accelerometer is ~~some m~~ an arrangement which measures the time required to traverse a fixed distance from which average acceleration may be determined from $S = \frac{1}{2} g t^2$. The latter method has the advantage of using time, ~~our most accurate~~ the quantity which can generally be determined c̄ greatest ease and accuracy, and of removing ~~an or~~ a heavy + expensive bit of instrumentation from the "pan" carrying the mass -

$\frac{F}{M} = A$

$$\text{Dist} = \frac{1}{2}\ \text{acceleration}\ (\text{time})^2$$
$$= \frac{\text{Force} \cdot \text{time}^2}{2\ M} \qquad T = \sqrt{\frac{2\ \text{mass dist}}{\text{Force}}}$$

From the above equations the rates of change of mass i.e. errors may be determined c̄ respect to the ~~other variable~~ rates of change (error) in other quantities -

$$\text{Mass} = K \cdot \frac{\text{Force} \cdot \text{Time}^2}{} \cdot \text{dist}^{-1}$$

Holding const: force + time + $dM = d\ \text{Dist}$

$$\frac{dM}{M} = K \frac{dD}{D}$$

dist. + force $\quad dM = K\, 2T\,dt$

& $\quad \frac{dM}{M} = K\,\frac{2\,T\,dT}{T^2}$

Time + dist.- $\quad dM = K\,dF$

& $\quad \frac{dM}{M} = K\,\frac{dF}{F}$

From these considerations certain elementary conclusions may be drawn. If the error in knowlege of the distance is reasonably constant then the distance should be as large as possible. The error in distance, which may arise from temperature dependent expansion and the like, must be carefully guarded against. Time errors will be multiplied by two and again all other things being equal the time period should be as long as possible which is consistent $\bar{c}$ a long distance