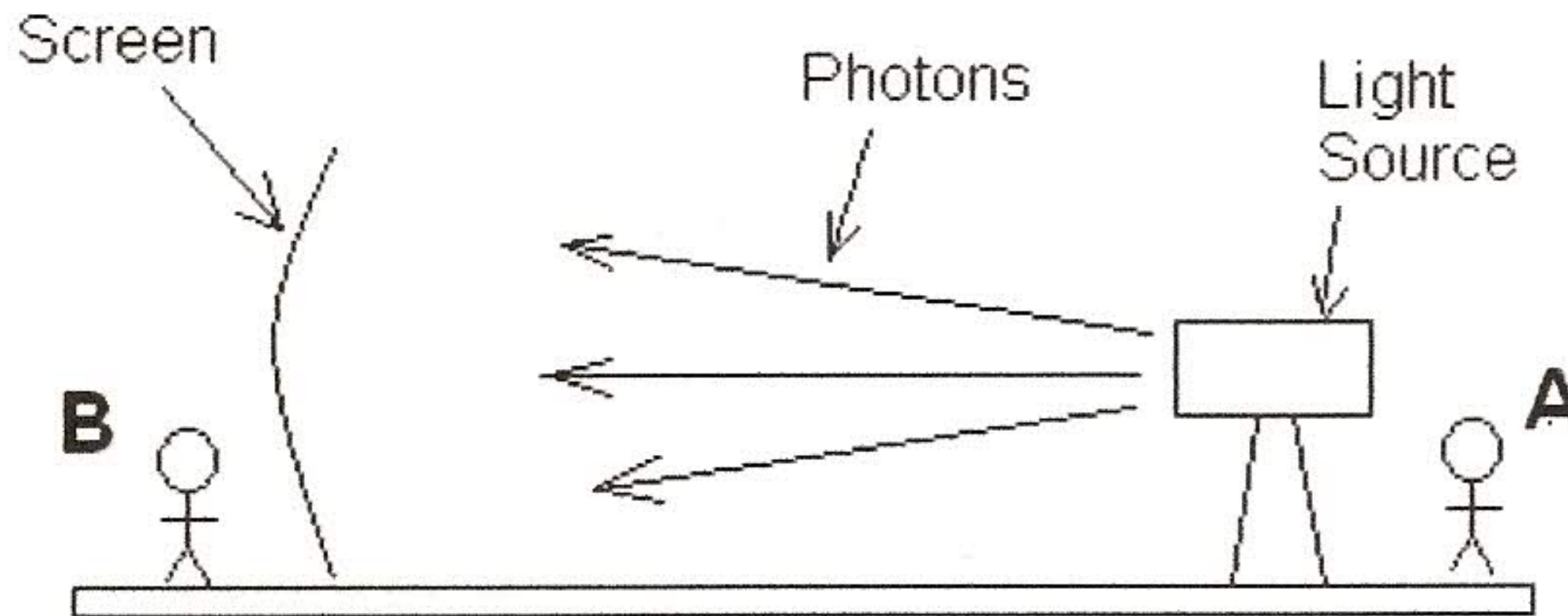


The articles *The Real Ladder Paradox*, *The Acceleration Law* and *Acceleration Dynamics* show how energy participates in acceleration experiments. In Newtonian physics, forces act only upon material mass. In Relativistic physics, energy also has mass. When the mass of energy is accelerated, there must also be a force associated with this acceleration.

### The Light Experiment

Figure 17 shows a platform floating in free space with an observer at each end.



**Figure 17.** Light shines from the source to the screen.

The observer A has a powerful light source (with battery). The light source is initially off, then is turned on for a period of time, then is turned off again. The observer B has a screen that absorbs light energy at 100% efficiency. Real experiments have shown that during the time that the light is on, the platform will experience a force that is a reaction to the momentum of the photons emitted by the light source (radiation pressure effect) and will experience a similar force caused by the photons being captured by the screen.

If the total energy emitted by the light is  $E$ , then one result of the experiment is a movement of energy  $E$  from a position near observer A to a position near observer B. Therefore, mass  $E/c^2$  has moved left from observer A to observer B. The platform begins the experiment with no velocity (seen by our primary reference frame) and must have no velocity at the end of the experiment. The Law of Conservation of Momentum requires that the platform move during the experiment so that the center of mass of the system stays in the same place as the light energy changes location. This is possible because the photons produce a force on a material when they are emitted, reflected or absorbed. The movement of the platform can be separated into three steps.

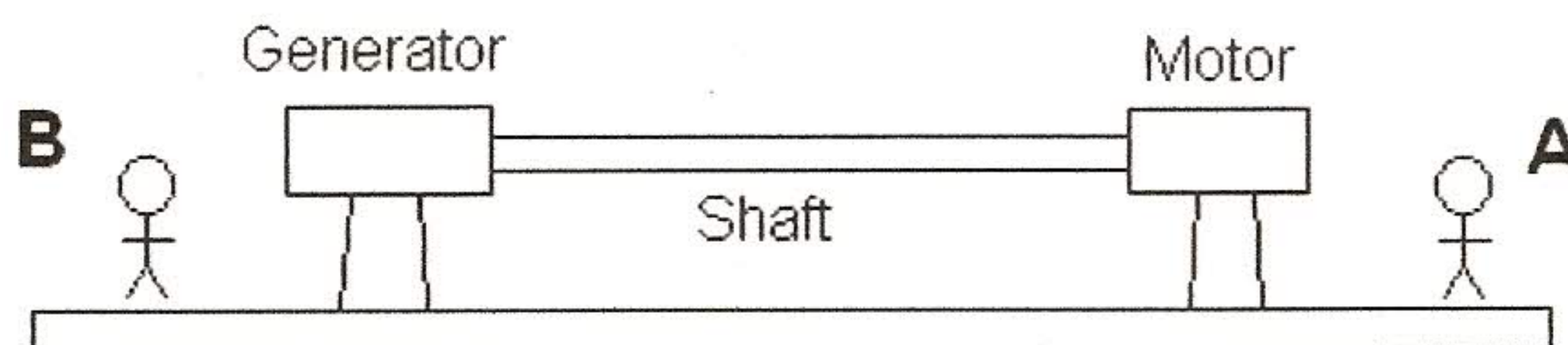
1. When the light source is turned on, the photons have a momentum to the left and impart a force on the platform to the right. Before the photons get to the screen, this force accelerates the platform to the right.
2. When the first photons hit the screen, the force on the screen equals the force

on the light source and is opposite in direction. While the light source continues to shine, the platform has a constant velocity to the right.

3. When the light source is turned off, there is no longer a force on it. The photons traveling to the screen continue to impart a force to the screen and decelerate the platform. As the last photon hits the screen, the platform velocity becomes zero.

### The Motor-Generator Experiment

A second experiment similar to the one of Figure 17 is shown in Figure 18.



**Figure 18.** The motor turns the generator using the shaft.

Again, a platform is stationary in the primary reference frame. A motor (and battery) are next to observer A and a generator (and battery) are next to observer B. The motor and generator are connected by a long rotating shaft. The motor is turned on for a period of time and sends energy  $E$  to the generator. Then the motor is turned off. This experiment is similar to the one of Figure 17. At the end of the experiment, mass  $E/c^2$  has been moved from observer A to observer B. The Law of Conservation of Momentum requires the platform to move to the right to keep the system center of mass in the same location.

The movement of the energy requires the identification of a new type of force that is not recognized in Newtonian physics. This is the Moving Energy Force (MEF). In the experiment of Figure 17, light also produced MEF's. As the energy  $E$  moves left down the rotating shaft, it generates a force to the right. There will be no attempt in this article to define how this is done. However, three steps can be identified to explain how the MEF's must move the platform.

When the motor is started, the generator will not feel this rotation until the signal of movement travels down the shaft. The maximum velocity this signal can move down the shaft is the speed of light. During this time, there must be a force on the motor that accelerates the platform to the right (step 1). This is one example of an MEF.

The platform will continue accelerating to the right until the signal of rotation reaches the generator and the shaft energy begins its conversion into battery electrical energy. When this happens, an MEF within the generator is equal in magnitude and opposite in direction to the one occurring in the motor. In this situation, the platform travels to the right at a constant velocity (step 2).

As the motor is turned off, the MEF at observer A stops and the MEF at observer B continues, decelerating the platform (step 3). When the signal of no more motor torque travels down the shaft and reaches the generator, all energy transfer stops and the platform is once again at zero velocity. As in the experiment of Figure 17, the platform has moved to the right to keep the system center of mass stationary.

From these two experiments, it seems like energy flows through a mechanism like water through pipes. Each twist and turn of the energy flow direction should produce a corresponding MEF similar to the Newtonian reaction force of the water flowing through pipes. The experiment of Figure 18 could be altered so that a battery at observer A could be heating a resistor at observer B. The platform would similarly have to experience MEF's associated with the flow of energy in the electrical circuit. The platform must move in the ways already described.

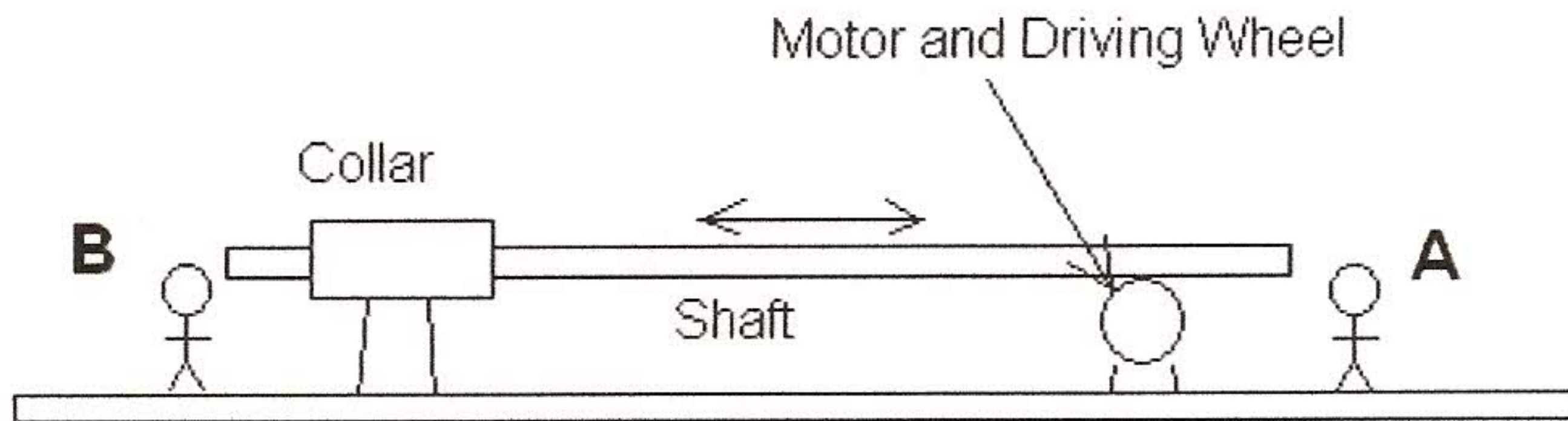
In another experiment, observer A has a spring which shoots a mass to observer B. Observer B also has a spring that catches the mass. Although the mass produces a reaction force on the platform as the spring accelerates it, the energy stored in the spring also produces a reaction force (MEF) on the platform as this energy leaves the stationary spring and become kinetic energy in the mass. The effect of the relocation of the material mass is just a minor complication to the mathematics of the analysis. The mass of energy  $E$  (spring potential energy) has been transferred and this transfer must produce MEF's to keep the system center of mass stationary. Traditional relativistic analysis does not account for the MEF in the way stated here. Instead, the relativistic mass of the moving material is increased by the factor  $(1-\beta)^{-1/2}$ . The relativistic mass is the material mass plus the mass of the kinetic energy and both must be accounted for in the dynamic experiment.

### **The Linear Motion Experiment**

In Figure 19, an experiment featuring linear forces is shown. The generator of the previous experiment is replaced by a collar that exerts a frictional force on a shaft that passes linearly through it. A motor (with battery) drives the shaft using a wheel as shown in Figure 19. The shaft can move to the right (producing tension in the shaft material) or to the left (producing compression). In both cases, the energy is moving to the left and the platform must move to the right in reaction to this energy movement.

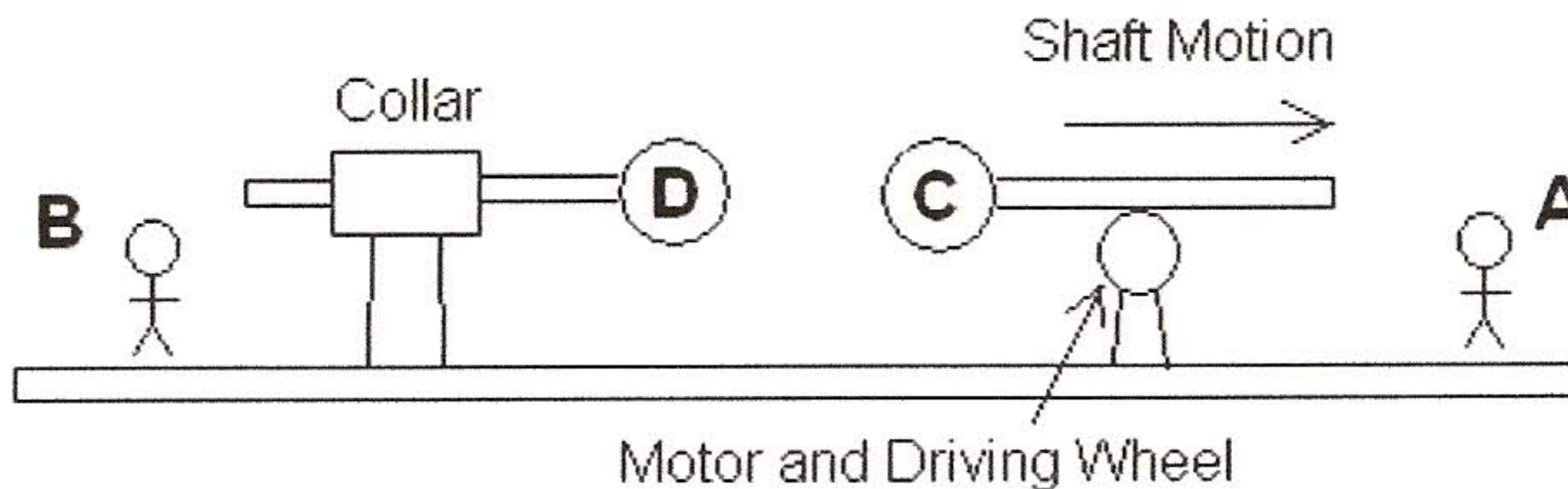
If the collar has no friction, then the experiment is a simple Newtonian analysis and the motions involved are well known. Therefore, the movement of the shaft and its effect on the platform can be figured separately and added to the effect of the movement of energy  $E$ . When there is friction in the collar, energy from the battery is transferred to the collar

and becomes heat energy. Regardless of the shaft motion, the MEF effect is always moving the platform to the right during the experiment.



**Figure 19.** A motor moves a shaft linearly.

The platform of Figure 19 can now be modified as shown in Figure 20.



**Figure 20.** A motor moves a shaft linearly using a field connection.

The experiment of Figure 20 is identical to that of Figure 19 except that the shaft in Figure 20 has a gap in it. As shown, objects C and D attach to the shaft. These objects have a field attraction for each other. This field could be electrostatic, magnetic or gravitational. The motor moves the shaft to the right, as in the previous experiment, but the friction collar is exerting just the right amount of force to balance the existing field attraction between C and D. So the shaft at observer B moves with the same velocity as the shaft at observer A and the distance between C and D is constant as the movement is taking place.

As before, there is an MEF at observer A associated with the movement of energy from

the motor. There is also an MEF at observer B associated with the heating of the friction collar. But now the “pipe” through which the energy is flowing has a region which is best described as “undefined“. It is not usual to think of a field as a “thing”. There is nothing to touch. There is nothing to measure except in the particular character of the field (e.g. magnetic fields are not measured gravitationally). But energy is crossing the field in predictable ways and the field is not being altered by this crossing.

Now we modify this experiment by holding the shaft attached to D fixed in the collar and allowing the motor to move the shaft attached to C. The motor still expends energy E but now there is no heat in the friction collar. Energy E is converted into field potential energy. This not only means that the “mass” of the field must be increased by the amount  $E/c^2$ , but the acquisition of this field potential energy must also produce an MEF on the platform.

It is hard to say with certainty what this means. Several observations can be made however. Is it possible that material itself has no mass? The mass that has normally been thought to be contained within the material is actually the sum of all the potential energies of the fields surrounding the material? Since material is made up of “atoms” and the atoms are composed of fields (and maybe other things), then how does the experiment of Figure 20 relate to the field interactions of atoms with their neighbors? Does iron that is magnetic have a greater mass than iron that is not magnetic? How does a field produce and MEF on material? Does the concept of MEF and the experiment of Figure 20 tell something about how gravitational fields work?

In summary, the fact that energy has mass requires the concept of MEF, so that the Law of Conservation of Momentum can be satisfied for the experiments shown. This is true even if relativistic velocities are not involved. MEF’s are not easily defined, nor are the specific ways in which they produce an interaction of energy and material. The MEF concept also reveals some of the properties of fields.